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A PRIZE OF ONE HUNDRED DOLLARS.

The ELECTRICAL REVIEW desires to publish an article upon the electric lighting central station superintendent — his duties, how he may best fit himself for them, what steps he must take to insure success in that profession, and what type of man is best fitted by character, experience, education and brain texture for employment under conditions of great responsibility by owners of such installations. We offer a prize of $100 for the best article of not less than three thousand nor more than five thousand words in length, received before May 1, 1901. Only articles written by members or associate members of the American Institute of Electrical Engineers, or members of the National Electric Light Association will be considered.

SEEING BY ELECTRICITY.

When it was announced, some sixty or more years ago, that intelligible signals could be sent for a long distance over metallic wires the statement started a ripple of incredulous laughter. When a bill was introduced in Congress favoring the construction of a line of telegraph wires some facetious member of that body at once presented another appropriating funds to build a railway to the moon. The two projects, he said, were equally feasible, and certainly equally sensible. The telegraph triumphed, however, and became the first of the electrical marvels which astonished the world during the century recently brought to a close. A few decades later the proposal to build a telegraph line under the waters of the Atlantic instantly secured a respectful hearing. It was, perhaps, due to the popular familiarity with the cable that no extraordinary incredulity was displayed when it was published abroad that speech could be transmitted by electricity, even to great distances. The world had grown accustomed to miraculous performances with which the magic name of electricity was linked. The telephone was hailed as a wonderful and beautiful invention. It was, as we now see in retrospect, more appreciated as the greatest triumph of human skill and invention in its earlier days than it is now when familiarity has made it commonplace. But its advent was, in a way, disastrous to the interests of science, for it thoroughly prepared the public mind for the reception of any marvel or of any alleged revolutionary discovery. It raised the expectation of the laity—of those outside the arcana of physical science—to a pitch such that nothing could greatly exceed it, while nothing short of the impossible could satisfy it. The accomplishment of telephony, the actual extension of the sense of hearing over miles of space, simply invited the imagination to conceive newer wonders. If one could hear a voice over vast stretches of wire, why should not he *see* a picture or a landscape as easily? Why, if one could speak with another through the electric agency, should he not also see him?

So natural a step it seemed from hearing to seeing that the discovery of the photophone — a method of conveying sounds and speech along a beam of light —was hailed at once as the precursor of a method for seeing along the same wires that so successfully transmitted sounds. Unfortunately the nature of the transmission was popularly overlooked. Electricity was the agent, and certainly it seemed that with its past record of achievement no task was beyond the powers of the subtle fluid. This view, though, did not take into account either the mechanism of the sending of sounds by electricity or the vastly different natures of the physical disturbances known respectively as sound and light.

So far there has been no very promising work in this field, although an occasional experimenter has made extravagant claims of successful accomplishment. It would be unsafe to say that seeing by wire is impossible, for nothing can well be stranger or appear more impossible of achievement than hearing by wire, but certainly little has been done towards solving the interesting problem, nor are there many phenomena connecting light and electrical action which seem to promise results in this direction. Still, we may believe that some day our descendants may be able to see as well as to hear the persons with whom they hold long-distance conversations.

It is interesting, in view of wireless telegraphy, wireless power transmission, wireless telephony and wireless electric lighting, to note that the price of copper remains high and the appearance of the wire-makers prosperous.

THE FACTORY AND THE FOREIGNER.

It has been a time-honored custom in the United States to permit visiting foreign engineers and manufacturers to inspect freely factories and other industrial establishments in this country, and to take pride in showing them our various advances in manufacturing and engineering. Indeed, this matter has gone to such an extent in some quarters that many of our most prominent manufacturing establishments, especially those having to do with electrical work, have become in a measure schools at which foreign visitors have been instructed in American ways of doing business and American methods of manufacture.

Coincident with the recent extraordinary expansion of American export trade, and the sharp rivalry in many lines of business which has been inaugurated by the perfection of American methods of manufacture and products, there has come a feeling of hostility toward us, perhaps natural under the circumstances, in many foreign centres of industry. Our competitors have suddenly awakened to the fact that we are rapidly outstripping them on account of perfected methods of production, and after the first shock of astonishment at this conclusion has passed their natural impulse is at once to discover the secret of our methods and to avail themselves of it, if possible.

To this end a representative visits the United States. It has been the custom for him to find the doors of factories and workshops wide open for his reception, and the managing officials of such establishments ready and willing to show him all they have to show—methods, machinery, appliances, and all the rest. Is it fair to ourselves to permit this state of things to continue any longer?

Probably the most bitter industrial competition that has ever been known will mark the first few years of the new century. The growth of this country and of its industries has necessitated the establishment of export markets, and hence the competition of our goods with those made in other countries. While a great part of our superiority in certain directions is unquestionably due to well-known agencies, still, every manufacturer must have some particular short cut—some trick of the trade which he has evolved himself, and which is his own private property. It is time, we think, that the manufacturers awakened to the necessity for keeping to themselves any information which may permit their rivals to take advantage of them. The natural pride with which we have exhibited, perhaps somewhat boastingly, our industrial establishments to the foreigner should be replaced with a still more natural caution for fear that he may learn something to our disadvantage in the course of his visit.

DECEITFUL RADIOGRAPHY.

In a recent number of the London *Lancet* is a thoughtful article dealing with perverted uses of the Rœntgen rays in surgico-anatomical operations. In the hands of an expert, possessed of a good technical knowledge of anatomy, the radiograph is capable of almost indefinite distortion, whereby extraneous objects may be made to appear as if located in the portion of the head or body submitted to the rays. Again, a picture of the brain made by the X-ray may show abnormal development in almost any portion as may be desired by the operator. As the *Lancet* points out, the average person accepts the ordinary photograph on faith as a likeness and the radiograph as a faithful portrait of what he can not himself find out about his interior physiognomy. But any one who has ever seen an "out-of-focus" photograph knows what deformities the camera is capable of producing. Cows can be made to seem all head, men all feet, houses all big windows and doors. When one considers that the radiograph is a record of nothing more than what the operator chooses to present, and when that presentation must be taken absolutely on faith, the importance of having an entirely trustworthy and accurate man to make the record is manifest. Even when the motives of the operator are honest he may obtain results which, if shown in a camera portrait, would stamp the result as a freak.

The physician upon whose paper the *Lancet* commented has sounded a valuable warning against unprincipled practitioners, and the journal goes one step further, cautioning the public against allowing any one other than an expert to experiment upon them. The burns and depilations resulting from the careless use of the Rœntgen rays have been discussed in these columns before and it is but to emphasize the warning of the English surgeon that the statement and the more specific warning are repeated.

Mr. Joseph E. Lockwood, one of the pioneer practical electrical men of the country, paid a well-deserved tribute to the work of Mr. William Stanley in the ELECTRICAL REVIEW last week. We thoroughly endorse the credit given to Mr. Stanley for his excellent early work in the alternating-current field, and believe that he is an inventor who is deserving of much praise for original and valuable effort which has not been confined to any one branch of the technical development of electrical application.

A journal called the *Manufacturer* has been having fun with us. In an article containing a plea for the adoption of the metric system it says:

Anent this bill [the bill for the adoption of the metric system in the United States], we have read, in technical papers, some editorials that rank, for linguistic, almost logarithmic, density with any ever furnished for the fun of involuted absurdity by Mark Twain at his best. One paper talks of Germany still using Whitworth and Stubb wire gauges, "for the simple reason," it says, "that aliquot even subdivisions, according to the multiples of two, using the inch as a standard of length, seem to come out nearer what is desired in practice than any decimal multiplication or subdivision of any of the metric units so far attempted." What does that mean? Does the metric system do away with two or one, or three, or any unit?

The paper referred to is the ELECTRICAL REVIEW. We may be dense—we are too dense to know what "logarithmic density" is—but we do know that the metric system, with its decimal subdivision, does away with "two or one or three of any unit" as working values so long as it remains decimal; it also eliminates the convenient eighths, sixteenths and thirty-seconds. And it has proved itself in actual practice immeasurably inferior to the English system of weights and measurements for engineering and manufacturing use. The question of its adoption will not be settled by law, but by the consensus of engineers and manufacturers. The Americans and British, who do the bulk of the world's manufactures, use the older system, while the Germans, who are trying hard to become effective competitors, have been obliged to adhere to the older wire and screw gauges.

THE INVENTOR OF THE SPEAKING TELEPHONE.

OPINION OF GRAY'S PATENT ATTORNEY CLEARLY SUSTAINING BELL.

BY GEO. C. MAYNARD.

The Washington representative of the ELECTRICAL REVIEW recently called on William D. Baldwin, the well-known patent lawyer of that city, and asked him to write a brief statement regarding Gray's claim "that he showed Bell how to make the telephone." Mr. Baldwin kindly dictated to a stenographer the explanation printed below. Mr. Baldwin is one of the most able, conservative and reliable patent lawyers in the country and no man in Washington stands higher in the profession. He has been engaged in active and extensive practice for many years and is probably better acquainted with the history of Gray's invention than any other man living. To the Gray interests he has been what Mr. J. J. Storrow was to the Bell company. As the attorney for Dr. S. S. White and the Harmonic Telegraph Company he prepared the Gray cases for the Patent Office and conducted all the litigation from the Summer of 1874 up to the time of the settlement between the American Bell Telephone Company and the Western Union Telegraph Company, and thereafter continued to represent the Gray patents, which passed under the control of the Bell company. As Mr. Gray had sold out his patents (for which he received $500,000), he had no pecuniary interests in the business after the settlement. The facts, as explained by Mr. Baldwin, give a very clear idea of the legal aspects of the matter and are of especial interest at this time:

MR. BALDWIN'S STATEMENT.

There can be no better authority on this question than Mr. Gray himself. In his preliminary statement, in the telephone interferences, filed November 20, 1878, he said:

"An incident which occurred in Milwaukee in the Winter of 1875 solved to my mind the problem of making a transmitter that would copy electrically the physical vibrations of the air produced by articulate sounds, and I determined to put this into practical shape and file it in the Patent Office. About the 15th of January, 1876, I went to Washington, where I spent some time with my attorney in the preparation of a number of cases that had been accumulating for several months. This required several weeks of time. While there I prepared and filed my caveat of February 14, 1876."

As in the oath to this caveat Gray swore that the invention was incomplete, and he needed time to perfect it, he certainly can claim no earlier date than this, and at the hearing of the interferences he disclaimed broadly the invention of the art of transmitting speech telephonically, claiming what he alleged to be the broader ground of the combination of a diaphragm and magnet capable of transmitting the composite tones necessary for the production of such speech. This disclaimer was rendered necessary by the fact that he had on February 21, 1877, written a letter to Bell in which he distinctly admitted that he did not claim to be the first inventor of this art of transmitting speech telephonically.

In his preliminary statement he continues:

"I constructed and used apparatus similar to that described in my caveat during the month of June or July, 1876; but being very pressingly engaged in the development of my harmonic or multiple telegraph system, I did not complete my application until October, 1877.

"Shortly after filing my caveat, I was notified of the pendency of an interfering application, but the notice of such interference was subsequently withdrawn. A few days after this Bell's Interfering Patent No. 174,465, of March 7, 1876, was issued. I was very busy at the time preparing for the Centennial Exhibition, and as on a hasty perusal of this patent I could not discover that it contained anything relating to an articulating telephone, I deferred the completion of my application until I could command the time to make the necessary apparatus. To this end I made several experiments in the exhibition building, as opportunities occurred. I talked about and explained this invention to a few persons, and intended to exhibit it before the exposition was over, and would have carried out my intention but for the fact, that, to my surprise (as this was the first I knew that any one was experimenting on articulating telephones), Professor Bell placed on exhibition a speaking telephone which he claimed to have covered by his patent, the application for which had been filed simultaneously with my caveat.

"I at first determined to say nothing to the judges about my work in that direction. Subsequently, however, I reconsidered the matter, and sent to Washington for a copy of my papers, but did not receive them until after I had become busily engaged in making preparations to exhibit my multiple telegraph system to the Western Union Telegraph Company on the line between New York and Philadelphia. My partner, Dr. S. S. White, being very anxious that no time should be lost in doing this, I was obliged to relinquish the matter of the articulating telephone for the time being. . . .

"In the Fall of 1877, upon being notified by the Office of the pendency of an interfering application, I completed and filed my applications, now in interference.

"The models filed with my applications were actual working instruments which had been successfully used by me."

All that Gray could possibly claim under this statement was that at the time of filing his caveat his invention had assumed the form therein disclosed, and yet, notwithstanding the fact that on March 7, 1876, he was notified of Bell's patent, and in June, 1876, he witnessed Bell's experiments at the Philadelphia exposition, he made no asseveration of his invention at the time of that exhibition, and did not reduce it to practice until some time in 1877, when he filed his applications.

As to Bell, it is sufficient to the purposes of this controversy to state that it is undoubtedly proved that his application was prepared in the Fall or Winter of 1875, was sworn to in January, 1876, was patented in March, 1877, was reduced to practice by him in May, 1876, and exhibited at the Centennial in the presence of numerous parties, including Gray himself, in June, 1876, and early in 1877 went into general public use.

February 21, 1877, Gray wrote Bell a letter, of which the following is an extract:

"Professor A. G. Bell,

My dear sir:

I give a lecture in McCormick Hall this city, Tuesday evening, the 27th inst., on the telephone as I have developed it. I also connect with Milwaukee and have tunes and telegraphing done from there. I should like to explain and exhibit your method of transmitting vocal sounds as well, but do not feel at liberty to do more without permission from you. I should explain it as your method and not mine, although the Office records show a description of the talking telegraph filed by me the same day yours was filed. The description is substantially the same as yours. I was unfortunate in being an hour or two behind you. There is no evidence that either knew that the other was working in this direction."

March 5, 1877, Gray wrote Bell, in part, as follows:

"Of course you have had no means of knowing what I had done in the matter of transmitting vocal sounds. When, however, you see the specifications you will see that the fundamental principles are contained therein. I do not, however, claim even the credit of inventing it, as I do not believe a mere description of an idea that has never been reduced to practice, in the strict sense of that phrase, should be dignified with the name invention."

In view of this voluntary concession of Gray, it is no wonder that he was compelled to withdraw from the interference on the broad issue, and contest the matter of the combination of the diaphragm and magnet, nor, in view of the developments of these and other well-known facts in the subsequent litigation, is it any wonder that the Patent Office and courts have uniformly sustained Bell's claim as the inventor of the speaking telephone.

In view of the facts stated, it seems useless to ventilate the subsequent attempts of Gray to recall his assertions and contest priority with Bell. Every tribunal and every counsel who have sided with Bell in this controversy have had all sorts of insinuations made against them; but, to say nothing of counsel, the idea that 15 or 20 judges would all decide a case one way without a firm belief in the merits of their decisions, involves a judgment of human nature too pessimistic for belief or argument.

In no single instance, it is believed, has the judgment of any court or tribunal been rendered adverse to the claim of Bell as the true, original, first and lawful inventor of the speaking telephone.

THE THEORY OF ALTERNATING DYNAMO ELECTRIC MECHANISMS—XVII.

BY W. ELWELL GOLDSBOROUGH.

ON PARALLEL CIRCUITS CONTAINING RESISTANCE, INDUCTANCE AND CAPACITY.

When we have a circuit, such as that shown in Fig. 44, containing resistance, inductance and capacity, upon which the electric pressure of an alternator is acting, the conditions of balance between the forces, as explained on page 183, and diagrammatically shown in Fig. 45, are dependent upon the values of the constants of the circuit, and

$$OA = E = I\sqrt{r^2 + x^2} =$$

the impressed electro-motive force.

$OB = I =$ the current flowing in the circuit.

$OC = I\,r =$ the resistance or effective electro-motive force.

$CA = I\,x =$ the reactive electro-motive force.

$$O\,a = Z = E \div I = \sqrt{r^2 + x^2} = \quad (151)$$

the impedance or the equivalent resistance of the circuit.

$O\,c = r =$ the ohmic resistance of the circuit, and $c\,a = x =$ the reactance or the reactive resistance of the circuit.

From the above it will be seen that when the resistance ($r = o$) equals zero, the reactance (x) equals the impedance (z); and when the reactance ($x = o$) equals zero, the resistance (r) equals the impedance (z) of the circuit.

Now since

$$E = I\sqrt{r^2 + x^2} \quad (154)$$

we can write

$$I = E\sqrt{\frac{1}{r^2 + x^2}} =$$

$$E\sqrt{\frac{r^2}{(r^2 + x^2)^2} + \frac{x^2}{(r^2 + x^2)^2}} =$$

$$E\sqrt{g^2 + b^2}, \quad (165)$$

when

$$g = \frac{r}{r^2 + x^2} \quad (166) \text{ and } b = \frac{x}{r^2 + x^2} \quad (167)$$

and by so doing the current is shown to be equal to the square root of the sum of two squares, or

$$I = \sqrt{(E\,g)^2 + (E\,b)^2}. \quad (168)$$

Therefore, as in Fig. 46, we can lay off $OB = I$, and construct on it as the hypotenuse the right-angled triangle ODB, in which $OD = E\,g$ and $DB = E\,b$. Then, since from (166) and (167)

$$\frac{b}{g} = \frac{x}{r} =$$

the tangent of the angle DOB, OD has the phase position of the impressed electro-motive force relatively to the current vector OB; therefore we can lay off OA

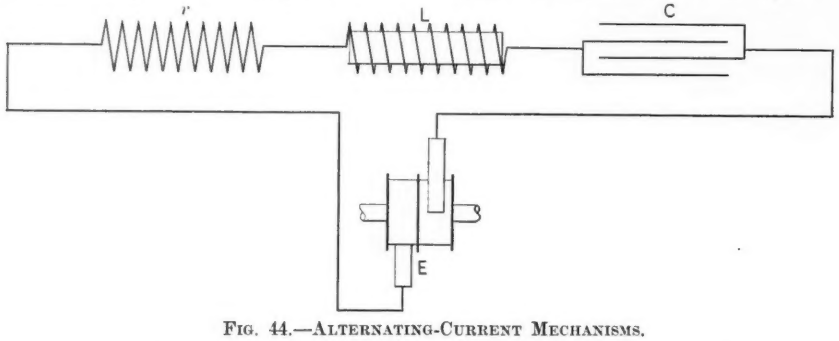


FIG. 44.—ALTERNATING-CURRENT MECHANISMS.

in Fig. 46 equal to E. I will, then, as in Fig. 45, be in advance of E by the amount of the angle ϕ or AOB.

It will now be evident that

$$OB = I = E\sqrt{g^2 + b^2} = \quad (165)$$

the maximum value of the current.

$OA = E =$ the impressed electro-motive force.

$OD = E\,g =$ the effective or useful component of the current, or that component of the current that is in phase with E.

$DB = E\,b =$ the wattless component of the current, or that component of the current that is at right angles to E.

On page 657, volume xxxvii, it is shown that the power developed in an alternating-current circuit is equal to the product of the virtual value of the electro-motive force multiplied by the virtual value of the current reduced in the ratio of one to the cosine of the phase angle between the electro-motive force and current, or that the mean power =

$$P = \bar{E}\,\bar{I}\cos\phi = \frac{E\,I}{2}\cos\phi. \quad (91)$$

Therefore, since OD is in phase with OA, OD is called the useful or working component of the current, for since the cosine of the phase angle between OD and OA is unity, the power developed by them is directly equal to the product of their virtual values.

In Fig. 25, on page 657, volume xxxvii, is shown a power curve derived from the curve of effective electro-motive force E_r and the current curve. In this case the current and electro-motive force are in phase, just as OD and OA of Fig. 46 are in phase with one another. But it is shown that the products of all the instantaneous values of E_r and the current are positive, and that, therefore, there is no negative work area developed; or that all the power represented by the power curve is spent in useful work. It follows, in the same way, then, that a plot of the power curve derived from the harmonic curves developed by the vector rotation of OD and OA of Fig. 46 would result in a power curve showing no negative areas, only useful positive working areas.

In the case of the vectors DB and OA, since DB is at right angles to OA, DB is called the wattless component of the current. The cosine of the phase angle ADB between them equals zero, consequently

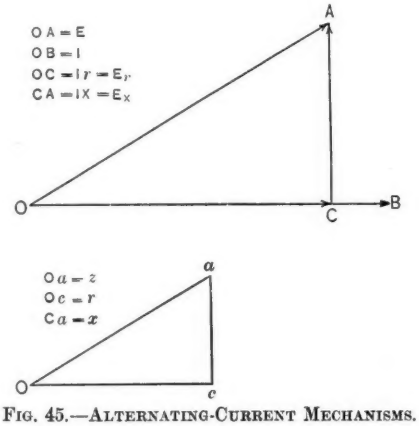


FIG. 45.—ALTERNATING-CURRENT MECHANISMS.

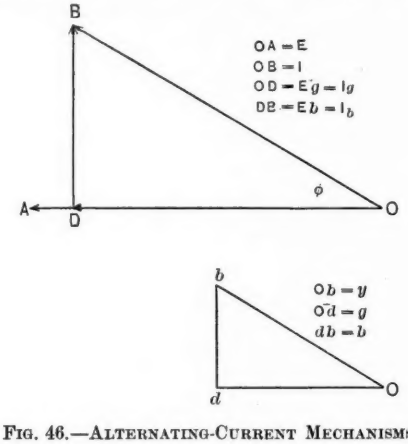


FIG. 46.—ALTERNATING-CURRENT MECHANISMS.

the result of the action between DB and OA is productive of no power in a period.

In Fig. 24 is plotted the energy curve that results from the products of the instantaneous values of the reactive electro-motive force E_l and the current. It will be remembered that the reactive electro-motive force has a phase displacement of 90° from the current, and it is shown that the mean power exerted by this

electro-motive force in a period is zero. In fact the relative positions of the reactive electro-motive force and current waves are such that their product produces a power curve having equal positive or useful and negative or wasteful areas, or an average work area equal to zero.

Since the vectors DB and OA of Fig. 46 have the same phase displacement as the vectors OB and OD of Fig. 24, they will develop by rotation similar and similarly situated wave forms and power curves. It is, therefore, evident that the vector DB of Fig. 46 represents a current that is productive of no useful work in one or more complete periods, and that it is truly a *wattless current*.

Having demonstrated the correctness of the definitions given of OD = E g = I_g and DB = E b = I_b, we will now turn to the consideration of (g) and (b) as factors in alternate-current working.

If, in Fig. 46, we lay off d b = b at right angles to O d = g, we have, from equation (165) and graphically,

$$O\,b = I \div E = y = \sqrt{g^2 + b^2} = \frac{1}{z}, \qquad (169)$$

= the *admittance* of the circuit = the reciprocal of the impedance of the circuit.

O d = g = the *conductance* of the circuit, and (166)

d b = b = the *susceptance* of the circuit. (167)

If equation (169) is written in its most general form,

$$y = \sqrt{g^2 + b^2} = \sqrt{\frac{r^2}{(r^2 + x^2)^2} + \frac{x^2}{(r^2 + x^2)^2}} =$$

$$\sqrt{\frac{1}{r^2 + x^2}} = \frac{1}{z} \qquad (169)$$

we see that when the resistance equals zero, the admittance equals the reciprocal of the reactance, and that when the reactance equals zero the admittance equals the reciprocal of the resistance.

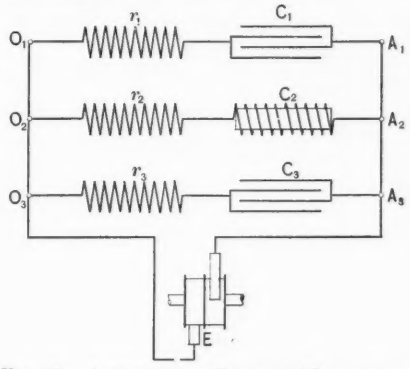


Fig. 47 —Alternating-Current Mechanisms.

If Fig. 47 be taken to diagrammatically represent an alternating-current system of parallel circuits containing resistance and reactance, the relation of the forces involved is shown by the construction in Fig. 48. A common electro-motive force is impressed at the terminals of each of the circuits, therefore the triangles of electro-motive forces for the individual circuits can be built up on the electro-motive-force vector OA as a common hypotenuse. Take, for example, the first circuit, $O_1C_1A_1$. The resistance of this circuit is (r_1) and its reactance (x_1), and the impressed electro-motive force has a value E. Then the current in the first circuit will have a value equal to

$$I = E\sqrt{r_1^2 + x_1^2}.$$

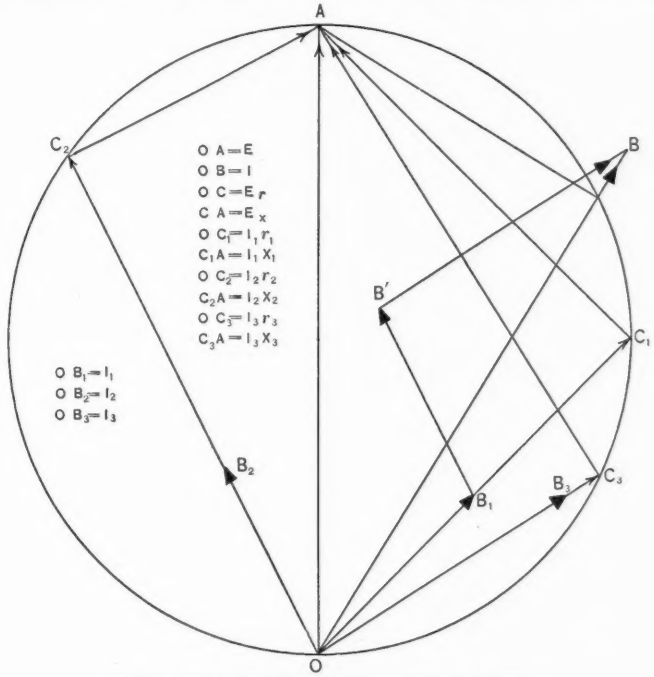


Fig. 48.—Alternating-Current Mechanisms.

Having determined the value of the current, from O describe a circle with a radius equal to $I_1 r_1$, and from A describe a circle with a radius equal to $I_1 x_1$: the intersection of these circles will give two points of which the one in advance of OA must be taken, as the first circuit has a capacity reactance factor. Thus the point C_1 is determined. In phase with OC_1 the current vector of I_1 is laid off as OB_1, and the vector diagram of the first circuit is complete.

The points C_2 and B_2 for the second circuit, and the points C_3 and B_3 for the third circuit, are located in a similar manner. The point C_2 is taken lagging behind OA as the inductance is the dominating reactive factor of the second circuit.

The value of the current supplied to the system by the alternator is determined by taking the vector sum of the currents in the individual circuits, for since the main current from the alternator must branch to supply the parallel circuits, the currents in the parallel circuits are its component parts. Current waves may, therefore, be combined in parallel systems and their resultants taken in the same manner in which electro-motive forces are combined in the case of series circuits, the mathematical demonstration of the correctness of the method being given on page 470, volume xxxvii.

Following the graphical method the currents of the first and second circuits are combined by laying off from the point B_1 the line B_1B^1 equal and parallel to the line OB_2, and the current in the third circuit combined with these by laying off from the point B^1 the line B^1B equal and parallel to the line OB_3. Then the resultant of the three component currents is OB, a vector which by its length and position represents the value and phase of the main line current.

In the case of circuits in parallel there is usually but one impressed electro-motive force, but there are as many currents as there are circuits, no two of which will probably be in phase either with one another or with the main line current. In the present case OB_1 and OB_3 are in advance of OB, while OB_2 lags behind OB.

Having determined the values and phase positions of the current vectors, from the points B, B^1 and B_1, we will drop perpendiculars upon OA, the impressed electro-motive-force vector, as shown in Fig. 49. By so doing I_1, I_2 and I_3 are projected upon OA and their corresponding effective components, OD_1, D_1D^1 and D^1D, thereby determined. But the sum of these projections is by construction equal to the projection of I, the resultant of I_1, I_2 and

I_3, on OA, or to the effective value of the total current. If then (g_1), (g_2) and (g_3) equal the conductances of the first, second and third circuits respectively, and (g) equals the equivalent conductance of the system,

$$OD_1 = E\,g_1,\ D_1D^1 = E\,g_2,\ D^1D = E\,g_3$$
$$\text{and } OD = E\,g,$$

therefore we may write

$$E\,g = E\,g_1 + E\,g_2 + E\,g_3 = E\,(g_1 + g_2 + g_3) \qquad (170)$$

and

$$g = g_1 + g_2 + g_3 = \frac{r_1}{r_1^2 + x_1^2} + \frac{r_2}{r_2^2 + x_2^2} + \frac{r_3}{r_3^2 + x_3^2} \qquad (171)$$

$$= \frac{r}{r^2 + x^2} \qquad (166)$$

by substitution, previous proof and definition. Here (r) and (x) are equal to the equivalent resistance and reactance respectively of the system of three circuits in parallel.

From (166) it follows that,

$$r = g\,(r^2 + x^2) = \frac{g}{g^2 + b^2} \qquad (172)$$

for since by (169)

$$\sqrt{g^2 + b^2} = \frac{1}{\sqrt{r^2 + x^2}}$$

therefore

$$(r^2 + x^2) = \frac{1}{g^2 + b^2}.$$

Hence we have that

The equivalent conductance of a system of circuits in parallel is equal to the arithmetic sum of the conductances of the several component parallel circuits.

The equivalent conductance of a system of circuits in parallel is also equal to the equivalent resistance of the system divided by the sum of the square of the equivalent resistance and the square of the equivalent reactance of the system.

The equivalent resistance of a system of circuits in parallel is equal to the equivalent conductance divided by the sum of the square of the equivalent conductance and the square of the equivalent susceptance of the system.

An Interesting Judicial Decision.

The opinion of Judge Thompson, of the United States Circuit Court for the southern district of Ohio, in granting an injunction restraining the Dayton Fan and Motor Company from infringing patents belonging to the Westinghouse Electric and Manufacturing Company, briefly alluded to before in these columns, is exceedingly interesting. The suit was brought to enjoin the defendant from infringing letters patent No. 511,559 and No. 511,560, granted to Nikola Tesla for the transmission of electrical power. The infringement complained of relates to claims one and two of the first patent and to claims one, two and six of the second, as follows:

"1. The method of operating motors having independent energizing circuits, as herein set forth, which consists in passing alternating currents through both of the said circuits and retarding the phase of the current in one circuit to a greater or less extent than in the other.

"2. The method of operating motors having independent energizing circuits, as herein set forth, which consists in directing an alternating current from a single source through both circuits of the motor and varying or modifying the relative resistance or self-induction of the motor circuits and thereby producing in the currents differences of phase as set forth."

Claims one (1), two (2) and six (6) of letters patent No. 511,560 read as follows:

"1. The combination with a source of alternating currents, and a circuit from the same, of a motor having independent energizing circuits connected with the said circuit, and means for rendering the magnetic effects due to said energizing circuits of different phase and an armature within the influence of said energizing circuits.

"2. The combination with a source of alternating currents, and a circuit from the same, of a motor having independent energizing currents connected in derivation or multiple arc with the said circuit, the motor or energizing circuits being of different electrical character whereby the alternating currents therein will have a difference of phase, as set forth.

"6. In an alternating-current motor, the combination with the field magnets or cores and independent energizing circuits of different active resistance and adapted to be connected with the line or transmission circuit, of an armature wound with closed energizing coils or conductors, as set forth."

The defence asserted that the inventions in suit were covered by a prior patent issued to the same inventor and hence that the patents specifically referred to are void for want of invention. This the Judge denied in a peculiarly lucid opinion, quoting authorities to show that the defense of double patenting could not be sustained. The Judge says:

"The Tesla system of electrical power transmission is founded on the use of the alternating current, as distinguished from the direct or continuous current. The alternating current is regarded as preferable for long-distance transmission. The properties of the alternating currents and the principal elements of the Tesla inventions were known, in a general way, to men learned in the science of electricity prior to the issue of the Tesla patents of May 1, 1888, but he was the first to successfully apply them to power transmission. In the specification of letters patent No. 382,280, Tesla himself fairly states the conditions fettering the transmission of electrical power prior to May 1, 1888, and the method adopted by him for bettering these conditions. He says:

"'I am aware that it is not new to produce the rotations of a motor by intermittently shifting the poles of one of its elements. This has been done by passing through independent energizing coils on one of the elements the current from a battery or other source of direct or continuous currents, reversing such current by suitable mechanical appliances, so that it is directed through the coils in alternately opposite directions. In such cases, however, the potential of the energizing currents remains the same, their direction only being changed. According to my invention, however, I employ true alternating currents; and my invention consists in the discovery of the mode or method of utilizing such currents.'

"This step in advance of old methods is conceded to be one involving a high degree of invention. But for many of the purposes of power transmission, the new or polyphase system was found objectionable on the score of expense, and then the next step was taken, by Tesla, which resulted in the invention of a method of operating motors which combined the advantages of the polyphase system with the inexpensiveness of the single-phase method. The new method employed but a single transmission circuit from the generator, but the motor circuits were made to serve all the purposes of the double circuits of the original patents. The distribution of the current, from the transmission circuit to the motor circuits, is described by Tesla in the specifications of patent No. 511,559, as follows:

"'The distribution of current between the two motor circuits may be affected by induction or by derivation. In other words, I may pass the alternating current from the source through one energizing circuit and induce by such current a second current in the other energizing circuit. Or, on the other hand, I may connect up the two energizing circuits of the motor in derivation or multiple arc with the main circuit from the source.'"

The opinion then goes on to show how the rotary field for starting the motor can be obtained by creating a phase difference between the motor circuits. The Judge quotes again as follows: "To conceive of the idea of creating a rotary field at the motor end of the circuit, not by sending separate impulses from virtually separate machines, but by dividing the single impulse from a single machine, and then causing these divisions of impulse to react against each other in such a manner as to produce rotation, appears to me to have been an idea of a highly inventive nature."

He considers that the production of a retardation of phase by artificial means, and its conversion from an element of disadvantage to one of usefulness in the transmission of electrical power, must be regarded as evidence of invention of a high order. A decree was entered granting damages for past infringement to the complainant, and an injunction restraining future infringement.

PERSONAL.

Mr. H. H. Windsor has resigned his position as managing editor of the *Street Railway Review,* of Chicago, and will hereafter engage in organizing and constructing electric railways. Mr. Windsor is succeeded in his former position by Mr. Daniel Royse, who for the past four years has been associated with Mr. Windsor.

Mr. Albert L. Rohrer, electrical superintendent of the General Electric Company's works at Schenectady, N. Y., was the moving spirit in the effort to establish a free public library in that city, and is credited with having induced Mr. Andrew Carnegie to contribute $50,000 toward its cost.

Mr. H. B. Kirkland, of New York city, general sales manager for the American Circular Loom Company, of Boston, started last week on an extended business trip which will take him to California and the Pacific coast cities.

Mr. Henry Gordon Stott, electrical engineer of the Buffalo General Electric Company, of Buffalo, N. Y., has been appointed superintendent of motive power of the Manhattan Railway Company, of New York city.

Professor Hubert V. Carpenter, formerly assistant in physics at the University of Illinois, has been appointed professor of physics and electrical engineering, at the Washington State College of Agriculture, Pullman, Wash.

In the department of physics at the Massachusetts Institute of Technology, Boston, Messrs. L. Derr, C. L. Norton and Dr. G. V. Wendell have been promoted to assistant professorships.

At the last meeting of the New York Electrical Society Mr. C. E. Knox was announced as a vice-president to succeed Mr. W. E. Burton, whose extended stay in England compelled him to resign.

Mr. J. B. Bennett has resigned his position as business manager of the *Street Railway Journal,* to become business manager of the *Municipal Journal and Engineer,* in which he has acquired an interest.

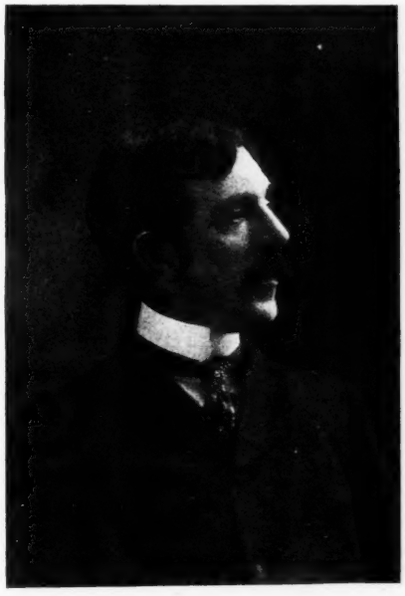
Mr. D. B. Dean, of the J. G. Brill Company, Philadelphia, Pa., is in New York city and will be here for several weeks on important business for his firm.

Mr. Geo. J. Kobusch has been elected president of the St. Louis & Belleville Electric Railway, of St. Louis, succeeding Mr. John R. Day.

Mr. C. L. Edgar, president of the Edison Electric Illuminating Company of Boston, was among the visitors to New York city this week.

OBITUARY.

Almerin H. Lighthall, a well-known engineer and inventor, was found dead in his room in the Bartholdi Hotel, New York city, on February 25, with a check for $10,000 grasped in his hand. He had been staying at the hotel for a week and had called a physician to attend him, who found that he was suffering from Bright's disease, which is supposed to have been the cause of his death. The check was the price of a patent Mr. Lighthall had sold a few weeks ago to a street railway company. Mr. Lighthall was born in Troy, N. Y., and was a graduate of the Rensselaer Polytechnic Institute of that city. He was a naval veteran of the Civil War, having served under Admiral Farragut at the battle of Mobile. He was one of the patentees of the cable street railway system, and superintended the building of a number of well-known cable roads in the United States and abroad. At one time he was chief engineer of the Third Avenue Railroad, of New York city. Under Mayor Gilroy Mr. Lighthall was appointed a city engineer for the Park avenue improvement. He leaves a widow, a son and a daughter.



Professor Palmer C. Ricketts.

William B. Banigan, one of the best-known business men of Providence, R. I., died at his home in that city on February 25 from pneumonia. Besides being a successful business man, Mr. Banigan was an enthusiastic sportsman. He was president of the Clark Automatic Telephone Company, of Providence; superintendent of the Marvel and other rubber mills, and agent of the Banigan estate. He had large business interests in Atlanta, Ga. He leaves a wife and one daughter.

Professor Palmer C. Ricketts, President of the Rensselaer Polytechnic Institute.

Professor Palmer C. Ricketts, director of the Rensselaer Polytechnic Institute, Troy, N. Y., has been elected president and trustee of the institute, succeeding the Hon. J. H. Peck, resigned.

Palmer Chamberlaine Ricketts was born at Elkton, Md., in 1856, and was graduated from the Rensselaer Polytechnic Institute in 1875. Upon his graduation he was made assistant in mathematics, and became assistant professor of mathematics in 1882. He was made professor of rational and technical mechanics in 1884 and director of the institute in 1892.

He has not confined himself to his institute work, but has been actively engaged in the practice of his profession as well. He was consulting bridge engineer for the Troy & Boston Railroad Company 1886-87, and held the same position for the Rome, Watertown & Ogdensburg from 1887 to 1891. As engineer of the public improvements commission of the city of Troy in 1891-93 he laid out all the new streets within the city limits and designed a complete system of sewerage for the city. In the practice of his profession he has also been engineer in charge of the design and construction of many other bridges, hydraulic works, etc.

Besides writing a "History of Rensselaer Polytechnic Institute," President Ricketts has been a constant contributor to scientific and other periodicals; to the reports of the United States Commission of Education, the reports of the New York State Board of Railroad Commissioners, the transactions of the American Society of Civil Engineers, and the proceedings of the Society for the Promotion of Engineering Education.

He is a member of the American Society of Civil Engineers, member of the Society of Mechanical Engineers, fellow of the American Association for the Advancement of Science, etc., and is a member of the Theta Xi Fraternity, the Troy Club, the City Club of Corning and the Union Club of New York. Professor Ricketts is also connected with the management of various societies and corporations; he is a director of the American Society of Civil Engineers, a director of the American Society for the Promotion of Engineering Education, vice-president and a director of the Trojan Car Coupler Company, a director of the Standard Railroad Signal Company, and a director of the Chamber of Commerce of Troy.

THE NIAGARA FALLS POWER COMPANY'S SWITCHBOARDS.

BY ARTHUR B. WEEKS.

Since the installation of the electric apparatus in the gigantic power-house on the Niagara River, nothing has been written regarding the many changes and additions which have taken place in connection with the switchboards and their accessories. The ensuing description and accompanying illustrations will therefore be of interest to those who have not followed recent developments and improvements in this direction.

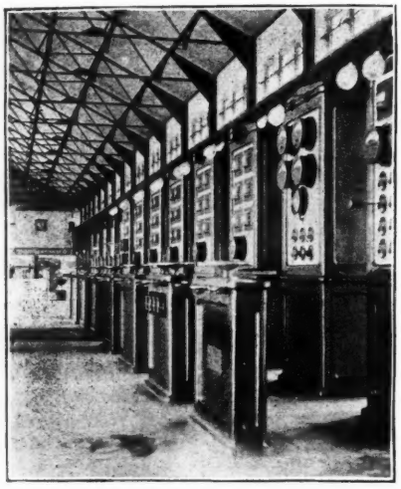


FIG. 1.—VIEW OF NO. 1 SWITCHBOARD, NIAGARA FALLS POWER COMPANY.

FIG. 2.—FEEDER STANDS (AT RIGHT), NIAGARA FALLS POWER COMPANY'S SWITCHBOARDS.

The switchboards of the Niagara Falls Power Company are unique, in that they are the only ones of the kind ever built. Many power-house visitors will remember them as the two large rectangular structures of white, enameled brick, occupying prominent positions in the centre of the long room; the switches being beneath the raised platform, in a space called the switch-room.

In Fig. 1 is shown a full view of No. 2 switchboard—the only photograph ever taken from this point of view. The first small pedestal is a stand for switch levers and rheostat wheel for a rotary converter of the Westinghouse make. Upon the panel immediately back of this stand are the meters for this machine. The plug-switches shown are for starting the rotary. This machine supplies current for the numerous direct-current circuits throughout the power-house, such as governor circuits, arc lamps, motors for inlet gates, oil-pump motors, and others, constituting what is known as the shop load.

The instrument panels are rectangular cast-iron frames, opening into the switch-room at the base and having hinged doors at the back, by which access is gained to the numerous instrument circuits and meters for calibrating. With the exception of the round meters, made by the Weston Electrical Instrument Company, all meters are of Westinghouse make, and are styled the Niagara type. They are let into openings in a white marble slab at the front of the panels.

The second panel is for two turbine exciters, with their ammeters and voltmeters. Below these is an air gauge, indicating a steadily maintained pressure of one hundred pounds. All switches are operated by compressed air. The levers seen on the front face near the top of the small stands operate the switches by admitting air to the switch cylinders.

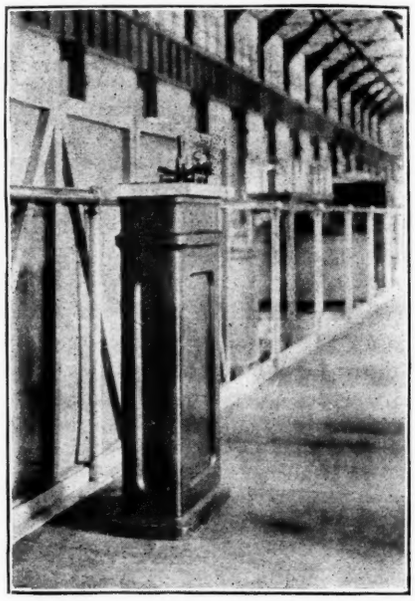


FIG. 3.—EMERGENCY SWITCH USED ON NIAGARA FALLS POWER COMPANY'S SWITCHBOARDS.

Next in order come five dynamo panels, each board controlling five of the huge dynamos, and every dynamo having a corresponding panel and switch stand. Each of these stands has levers for field circuit-breaker and switch, also a rheostat hand wheel, and two alternating-current switch levers. Upon the panels are the ammeters, voltmeters, and wattmeters for both phases. The round meter below is a Weston field ammeter. The field rheostats are beneath the floor, in a recess extended from the subway through which the wires are carried to outside circuits.

The stand and panel of the cross-connecting switches come next beyond the dynamo panels. Connecting the switchboards, for the purpose of gaining assistance from the other, can be accomplished by these cross-connecting switches; the capacity of an alternating-current, cross-connecting switch being identical with that of a dynamo switch, viz.: 5,000 horse-power. On the constant-current switch panel are four differential wattmeters, one for each phase of both the No. 1 and No. 2 alternating-current bus-bars, indicating the amount and direction of the current passing over the cross-connecting cables. The direct-current instruments upon this constant-current switch panel are two differential ammeters, and

a differential voltmeter. The voltage of the direct-current bus-bars of both boards is ascertained here, by inserting a plug-switch into each receptacle respectively. The use of one rotary and two turbine exciters for each board will bring about several combinations for exciting current, with the two sets of direct-current bus-bars, and their cross-connecting switches. Upon the cross-connecting panel are both alternating-current and direct-current connections for paralleling similar bus-bars of both boards. The synchronoscopes

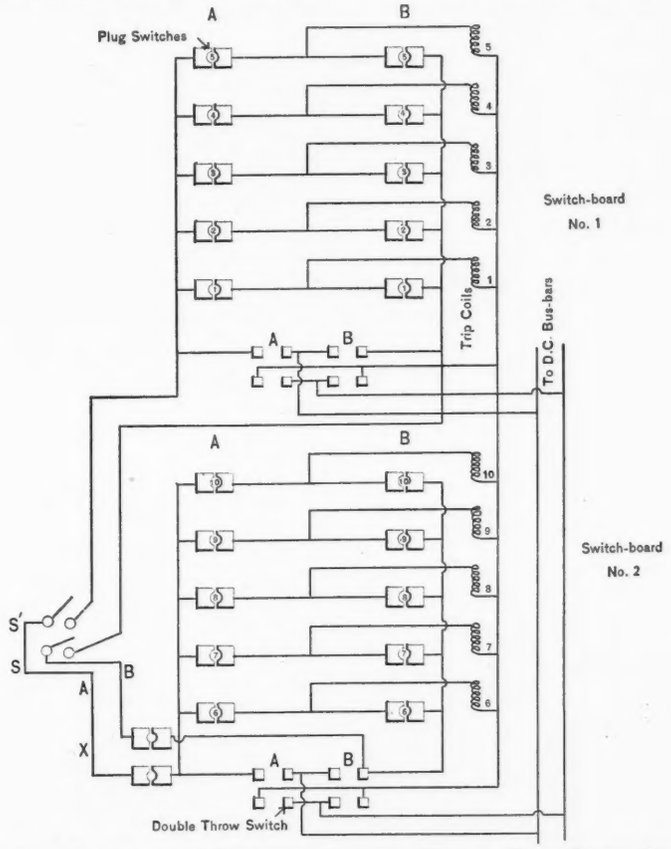


FIG. 4.—CROSS-CONNECTION OF EMERGENCY SWITCHES, NIAGARA FALLS POWER COMPANY.

in present use are at the top of the panels between the pilot lamps.

Fig. 2 shows stands of eight feeders, having two incandescent lamps on each phase, seen through openings near the tops. These stands have levers for No. 1 and No. 2 alternating-current bus-bars. Upon the top of each is an annunciator, which indicates on short-circuits the feeder giving the trouble. Often the feeder switch can be opened when the short-circuit lets go for a time, thus avoiding a shutdown. When this is done, however, great care is necessary; for should the short-circuit still exist, or come on when opening the switch, a most destructive arc would follow, causing a shutdown of itself. A feeder switch can be safely opened with a load of 5,000 horse-power, though this is not advisable when it can be avoided. By waiting a moment, the arc is usually interrupted, as the meters indicate. Integrating wattmeters for each feeder are placed in the office. The Stanley ground-detector is connected to each phase of all alternating-current bus-bars. Recording voltmeters register the voltage for twenty-four hours continuously. A compensator connected with the Buffalo transmission circuits indicates the voltage at the Buffalo terminus.

In the early history of the power-house, short-circuits were of frequent occurrence, but constant improvements have eliminated most of these troubles. Each factory has a circuit-breaker which can be depended upon to open the circuit when a feeder is affected, unless the short-circuit occurs in the cables between these places and the power-house, which is not likely to take place. At one time, fuses of 5,000 horse-power capacity were placed upon each feeder under the switchboard; but experience proves circuit-breakers better.

A most important device upon each switchboard is the emergency switch, shown in Fig. 3. Its object is to open the field circuits of the dynamos involved when under severe short-circuits. There are times when the short-circuit will burn itself clear. This switch is not intended for these cases, nor for those where the faulty feeder can safely have its switch opened. But for persistent short-circuits, this arrangement, very simple in its construction, is quick and positive in operation. The accompanying diagram indicates its connections. As shown, the entire load can be thrown off from either board, when alternating-current bus-bars are in parallel. This can be done only when the alternating-current, cross-connecting switch is in, for this lever opens and closes a small switch which completes the circuit between the two emergency switches. Ordinarily both boards are in parallel on No. 2 bus-bars.

Before the present Westinghouse turbine exciters were put in operation, rotary converters taking current from alternating-current bus-bars were used as exciters. At that time, when a severe short-circuit

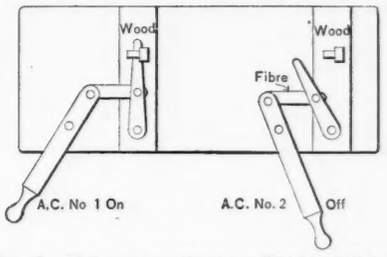


FIG. 5.—EMERGENCY SWITCH, NIAGARA FALLS POWER COMPANY'S SWITCHBOARDS.

came on, the bus-bar voltage would drop very low, causing the transformer to drop out of step and stop, losing the load entirely. Now, however, the case is different, and recourse must be had to the emergency switch, which is operated by hand.

A trip-coil, so called, is a coil of fine wire placed about the core of the circuit-breaker solenoid, which when energized draws up the latch and releases the circuit-breaker. The circuit-breakers are of the well-known Westinghouse make. Ere long No. 1 switchboard, which now has four feeder stands in use for the Buffalo transmission line and one for a local circuit, will be given over entirely to the Buffalo lines. There will then be five dynamos, five feeders and twenty transformers operated from No. 1 board for sending current to Buffalo, 26 miles distant, while No. 2 board will supply the local feeders entirely.

The officers having in charge the electric apparatus of the Niagara Falls power-house have perfected its system to a very high degree of excellence. It has been uphill work from the beginning, since every portion of the plant was, because of its magnitude, necessarily a new departure. For this reason, more credit is due to the energy and inventive ability of these officers than one is likely to realize.

Westinghouse Electric and Manufacturing Company's Directors' Report.

To the stockholders of the Westinghouse Electric and Manufacturing Company:

On March 31, 1897, the date of the last balance sheet submitted to the shareholders, the surplus of the company was $2,401,664.28.

On December 31, 1900, the surplus balance amounted to $4,693,197.20 after having in the meantime from current earnings written off $2,786,719.14, and in addition there has been paid:

Interest on debenture certificates, collateral trust bonds, dividend scrip and other indebtedness, $891,293.09.

Dividends upon the preferred stock, $1,049,122.46.

Dividends upon assenting stock, $605,512.71.

The net shipments or sales have been as follows:

For the year ending March 31, 1898, $4,378,060.30.

For the year ending March 31, 1899, $6,901,760.17.

For the year ending March 31, 1900, $11,963,646.33.

Which latter figures will be very considerably exceeded during the fiscal year ending March 31, 1901.

It is believed that the foregoing record of progress will be satisfactory to all stockholders, and if some should be surprised that more complete statements have not been previously submitted to them, it can only be said that the directors, as well as the stockholders who own the largest amounts of stock, have believed that in view of the existing keen competition and the general attitude toward industrial enterprises, the interests of all would be served by avoiding, to as great an extent as possible, giving undue publicity to the affairs of the company.

The greatly increased demand for electrical apparatus has necessitated large additions to the works and machinery at East Pittsburgh, with a corresponding increase in capital requirements. The company's interests abroad have also assumed large proportions, it having, in addition to its ordinary shares in the British Westinghouse Electric and Manufacturing Company, Limited, a cash investment of $750,000 in the preferred shares of that company, besides a considerable sum in the company's other European business.

The rapid development in the use of electrical machinery warrants the belief that even the present large facilities of the company will be insufficient to meet the demands, and therefore it is the intention of your directors and managers to further increase the facilities of the company as rapidly as circumstances warrant.

Of the $3,500,000 of the company's debenture certificates, $150,000 have already been retired in accordance with the provisions of the agreement under which they were issued, and a further $150,000 have been purchased for retirement July 1, 1901. The annual charge of $150,000 for sinking fund or retiring purposes will be cared for by the earnings, without other provision in regard thereto.

To meet the already increased capital requirements of the company, which can not be cared for from the earnings without hardship to the shareholders, $3,000,000 of assenting stock, sold at the best price obtainable, but not less than par, will suffice.

Your directors, however, having in mind the constant growth of the electrical industry, have decided to recommend that the capital stock of the company be increased from $15,000,000, the present authorized amount, to $25,000,000, such increase to consist of shares of the same character as those now outstanding and known as second preferred or assenting stock, to be issued from time to time as the directors in their judgment deem to be to the best interests of the shareholders.

By order of the board,

GEORGE WESTINGHOUSE,
President.

Pittsburgh, Pa., February 20.

At a meeting of the stockholders, held in Pittsburgh, February 20, 1901, it was decided to increase the capital stock $10,000,000, making the total authorized issue $25,000,000, including the $4,000,000 first preferred. It is not proposed to sell more than $3,000,000 of the authorized new stock at this time.

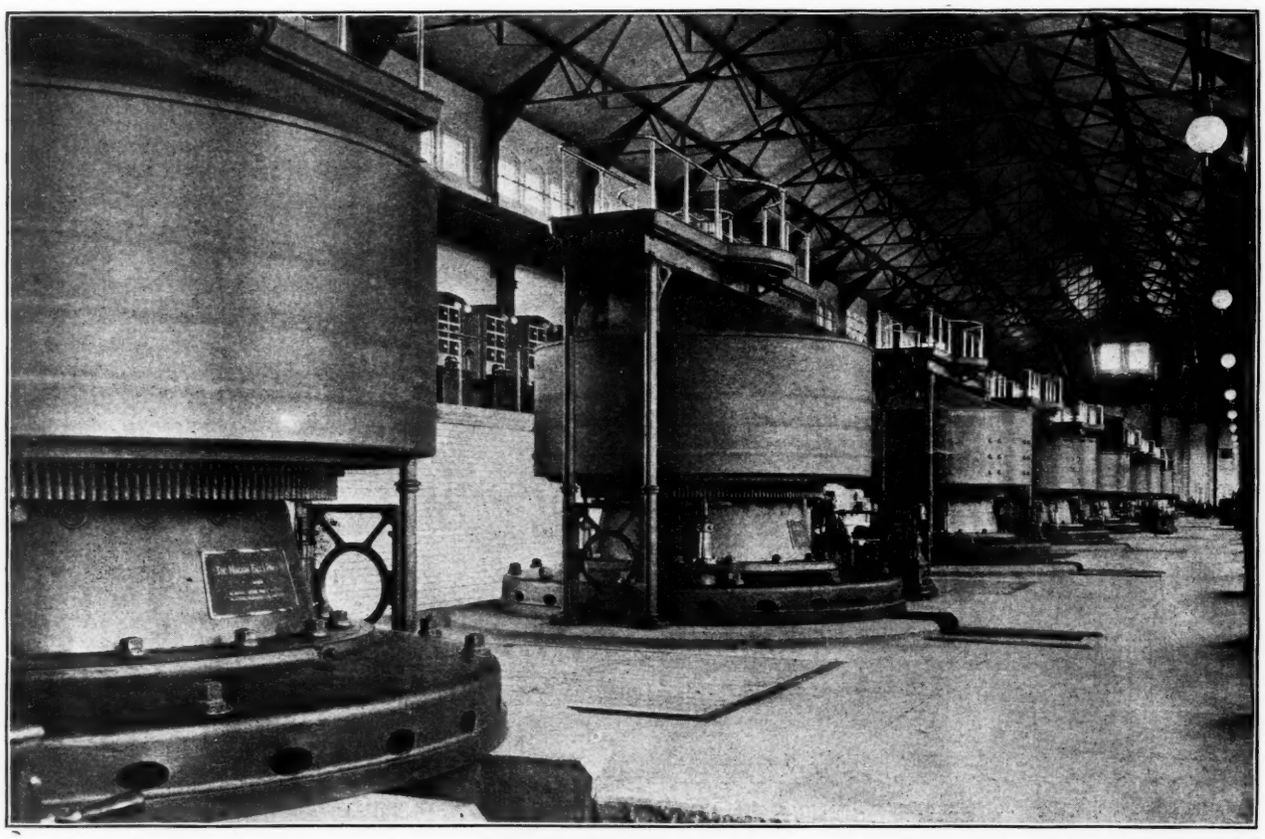


FIG. 6.—A VIEW IN THE GENERATOR ROOM OF THE NIAGARA FALLS POWER COMPANY. (See page 276.)

A Novel Electric Sign.

Upon the front of a building facing the small park at the intersection of Broadway and Columbus avenue, at Sixty-fifth street, in New York city, there is now in operation an electric sign of novel and

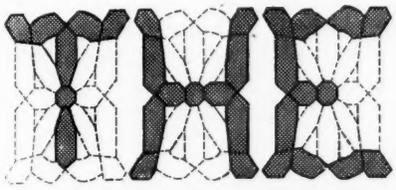


FIG. 1.—THREE "MONOGRAMS" OR UNITS USED IN A NOVEL ELECTRIC SIGN.

highly successful construction, employing a principle which permits any legend or device to be spelled out up to the capacity of the sign—48 letters—and changed as often as may be required.

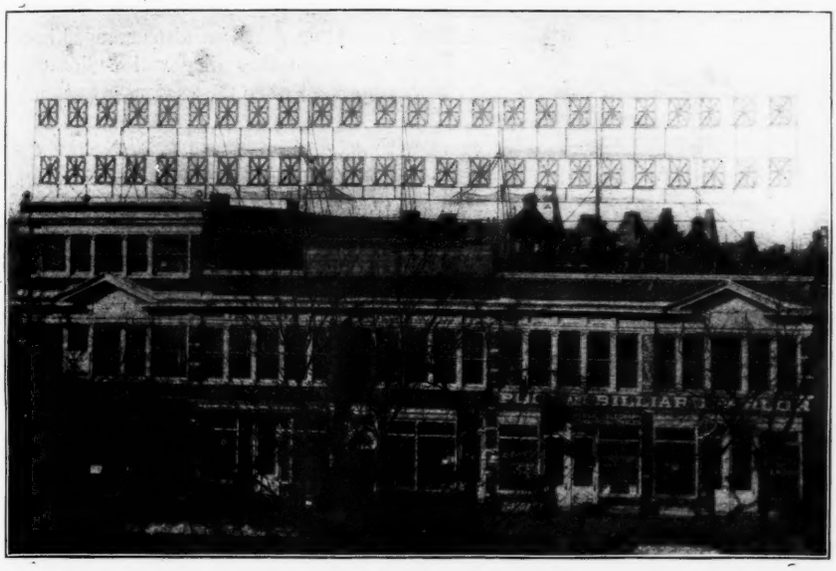


FIG. 2.—AN ELECTRIC MONOGRAM SIGN COMPOSED OF FORTY-EIGHT UNITS, TOTAL LENGTH, 128 FEET.

The "monogram," or unit, which, when appropriately connected, becomes a letter, is composed of 21 boxes or compartments, each containing an incandescent lamp of eight candle-power. The fronts of these boxes are covered with ground glass and, as the illustrations clearly show, by lighting the lamps in certain combinations any letter of the alphabet or any figure may be exhibited.

The Sixty-fifth street sign consists of 48 monograms, each four feet high, the total length of the sign being 128 feet. At present this sign is being used for advertising purposes, certain legends being repeated at intervals of from two to three minutes upon the electric letters. To accomplish this purpose the necessary contacts for the illumination of lamp groups in each case are made by means of bars placed on the periphery of a cylindrical drum, which is revolved by a small motor, thus making the action of the sign entirely automatic.

The monogram is the invention of Mr. G. L. Mason, and is the outgrowth of a considerable series of experiments extending over some time and looking to the perfection of the shape and design of the various elements entering the letter. It has been discovered that 21 compartments, arranged as shown in the illustrations, are sufficient to exhibit very clearly any letter or numeral, and that the average number of them in use or illuminated at one time is eight; hence these letters require at their normal consumption the lighting of only eight lamps for each. In the sign at Sixty-fifth street it has been discovered that, under the rates paid for electric current in New York city, the expense of operating the sign continuously is in the neighborhood of two and one-half cents per hour per monogram, or, say, 35 cents per hour for a 14-letter sign, which is about the average size.

In experimenting last Summer, the Mason Monogram Company, of New York city, the makers of the sign herewith described, constructed a combination letter or monogram 36 feet high, which was set up on the Palisades of the Hudson River, opposite the northern extremity of New York city. It was viewed from across the river in order to determine a number of points connected with the shape, size and general design of the letters. This was probably the largest electric letter that has ever been made.

Municipal ownership will soon be tried in Conway, Ark., as the town has purchased the electric light plant for $8,500.

Brutal, Bungling Electrocution.

[*From the Chicago Times-Herald.*]

The advocacy of electrocution appears to be based upon the assumption that it is a safe and humane method of disposing of criminals. As a matter of fact, it is brutal, bungling and unsatisfactory, as shown by the electrocutions in New York state. Commenting upon the measures for the reintroduction of capital punishment in Colorado the ELECTRICAL REVIEW says:

A feature of the new bill before the legislature is the adoption of electrical execution patterned after the infamous example of New York state. Doubtless the legislators of Colorado are not fully aware of the facts in connection with this method of ridding the world of criminals or they would hesitate. It is sincerely to be hoped that the opponents of the electrical method may win in the contest now going on, even if it is necessary to continue punishing condemned criminals by other than capital methods. Colorado can better afford to hang its condemned criminals than to institute the outrageous system of tortures still unhappily in vogue in New York.

One would hardly expect the leading electrical journal in this country to oppose electrocution if the process were a scientific or humane method for executing criminals. But when this journal characterizes it as an "outrageous system of torture" the legislatures of Colorado and Illinois will do well to go slow in trying to improve upon the hangman's rope.

The Automobile Transportation Law.

Senator T. C. Platt's bill providing for the carriage of petroleum-propelled vehicles on steam or other vessels plying on navigable waters has become a law. One restriction only is imposed; namely, that all lights or fire on any such automobile

FIG. 3.—A NIGHT VIEW OF THE ELECTRIC SIGN SHOWN IN FIG. 2.

vehicle must be extinguished before the machine goes aboard the vessel. The signing of this bill by the President relieves automobilists of the annoyances to which they have heretofore been subjected by their inability to take their machines across ferries throughout the country.

Recent Electrical Patents

Guglielmo Marconi has been granted another patent on an improved receiver for electrical oscillations in his wireless telegraphy system. In his former patent he described a receiver in which the aerial conductor was connected to a "capacity" which might be the earth, through the primary of an induction coil, while the terminals of electrical oscillations—for instance, a coherer or other imperfect contact—were connected to the secondary. According to this invention this secondary is broken in the middle or wound in two parts, the inner ends of the wire being connected to the local-battery circuit, which usually includes a relay working an ordinary telegraphic receiving instrument, while the outer ends are connected direct to the detector. It is advantageous also to place the condenser across the inner ends. The accompanying illustration is a diagram showing the present improvement. Fig. 1 is a diagram of the improved apparatus, and Figs. 2 and 3 show coils which the inventor claims operate successfully. In Fig. 1, A is the aerial conductor, connected to one end of the primary j' of an induction coil, of which the other end is connected by E to a capacity, which may conveniently be the earth. j^2 is the secondary of the induction coil, wound in two parts, the outer ends being in connection with the terminals of a detector T, while the inner ends are connected to the two plates of a condenser j^3. B is a battery, and R a relay, connected to the condenser j^3 and working an ordinary telegraphic instrument. c' c^2 are choking coils, whose object is to prevent oscillations generated in the winding j^2 from running into the battery circuit, which would weaken the effect of the oscillations on the detector T. Figs. 2 and 3 show instances of coils with which very good results have been obtained. These diagrams are greatly enlarged half-longitudinal sections, but are not strictly to scale. In place also of showing the section of each coil or layer of wire as a longitudinal row of dots or small circles, as it would actually appear, it is for simplicity shown as a continuous longitudinal straight line. The following are the details of the coil shown in Fig. 2: The primary j', wound on a core j .6 centimetre in diameter, consists of 100 turns of copper wire .037 centimetre in diameter insulated with single silk and coated with paraffin-wax. The secondary j^2 is of copper wire .019 centimetre in diameter insulated with single silk covering and is wound over the primary, commencing in the middle and in the same sense as the primary. Each half of the secondary is in layers of the following number of turns: first layer, 77; second, 49; third, 46; fourth, 43; fifth, 40; sixth, 37; seventh, 34; eighth, 31; ninth, 28; tenth, 25; eleventh, 22; twelfth, 19; thirteenth, 16; fourteenth, 13; fifteenth, 10; sixteenth, 7; seventeenth, 3, making 500 in all. The following are the details

Fig. 1.

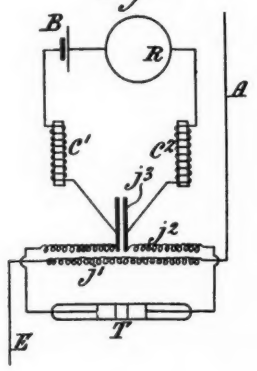


Fig. 2.

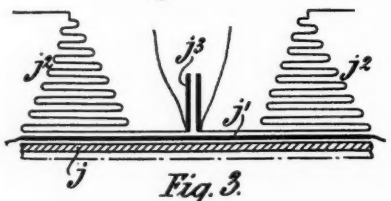
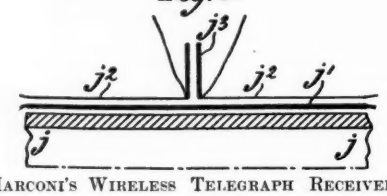


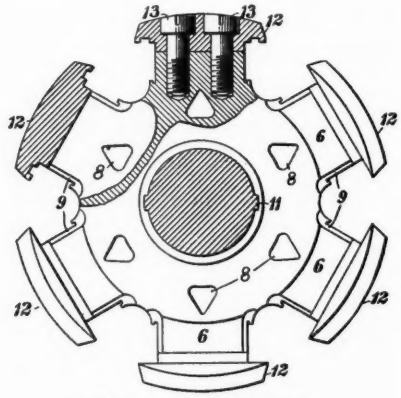
Fig. 3.



MARCONI'S WIRELESS TELEGRAPH RECEIVER.

of the coil shown in Fig. 3: The primary, wound on a core 2.5 centimetres in diameter, consists of 50 turns of copper wire .7 centimetre in diameter insulated with single silk covering. The secondary is of copper wire .005 centimetre in diameter insulated by a single silk covering and is wound over and in the same sense as the primary. Each half of the secondary consists of 160 turns in a single layer. These coils give the best results when the length of the aerial conductor at each station is 150 feet. "When using coils in which the secondary winding consists of one layer only, I have noticed best results when the length of the secondary winding is approximately equal to the length of the aerial conductor employed at the transmitting station."

A new rotary field magnet adapted especially for high speeds has been invented by Benjamin G. Lamme, of Pittsburgh, Pa., and the patent which has been obtained thereon has been acquired by the Westinghouse Electric and Manufacturing Company. The body portion of the core is built up of a plurality of sections, each of which may consist of thin laminæ if desired, or of solid construction. Each of the sections or divisions is provided with a plurality of polar projections, the number of which, of course, depends upon the speed at which the field magnet is to be rotated and the frequency of the alternations desired. Each section is also provided with a shallow annular recess on each face, so that when they are in position annular ventilating spaces will be provided between the adjacent divisions or sections. Lateral openings are also arranged in each division so that they will be located in alignment when the sections are assembled



ROTARY FIELD MAGNET.

and thus provide air passages extending through the core from end to end and communicating with the annular passages. Each of the polar projections is also provided on each side with one or more grooves so that air circulation may take place between each coil and the polar projection on which it is located. The internal diameters of the sections or divisions of the core vary progressively from end to end, the diameter of the first section being the greatest and that of the last being the less and the shaft has corresponding diameters, the lengths of which are a little less than the thicknesses of the corresponding divisions of the core, so that these divisions may be pressed onto the shaft and held firmly in engagement therewith and also in engagement with each other. Suitable feathers or splines are employed to prevent relative movement between the magnet and the shaft. In order that the several divisions or sections of the core may be still further

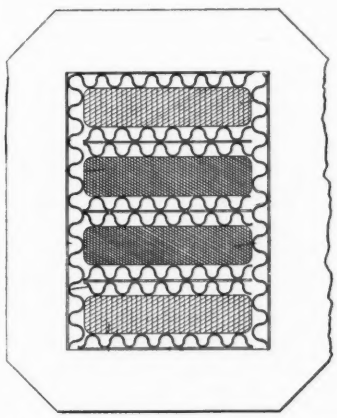
anchored in position and the coils also be held securely in position on the polar projections against the action of centrifugal force; a comparatively heavy bar or cap plate is provided for each aligned set of polar projections. The outer portions of these plates are wider than the projections and are fastened thereto by means of bolts or set screws which engage in the ends of the polar pieces of each section.

A new closed-conduit electric railway that embodies unique features has recently been patented and is constructed as follows: A conduit is located between the rails and at some distance below the level of the street. This conduit is provided

Closed Conduit Electric Railway.

with inverted cup-shaped receptacles at suitable distances apart, the upper faces of which are on a level with the surface. A flexible conductor is located within the conduit, and is connected to slidably mounted armature members arranged within the cup-shaped receptacles. The car carries a collecting shoe that is adapted to bear upon several of the cup-shaped receptacles, the central portion having a magnet, which is arranged to attract the armature within the cup and draw it into engagement with the upper face of the same, thus closing the circuit.

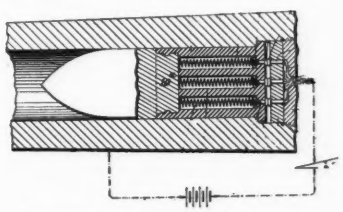
For the purpose of separating the coils of a transformer, so that they will be thoroughly insulated from each other, and at the same time to allow for the free circulation of a fluid, Ferdinand Schwedtman and Waldo A. Layman, of St. Louis,



Separating Partition for Transformer Coils.

Mo., have devised separating partitions of a novel character. These partitions each comprise a flat plate having on one or both faces corrugated sheets which thus hold the several coils apart, but permit the ready passage of the fluid.

A unique idea recently brought forth by a couple of Englishmen, Messrs. William Fries-Greene and Percy Knell, of London, is a cartridge that is to be fired by electricity. According to this invention, the charge employed consists of some material which, upon the passage of electricity through an electric circuit of which it forms a part, becomes vaporized either instantaneously or more or less quickly, as may be required. As materials suitable for the purpose, magnesium, lead or tin alloys may be employed either in the form of twisted wires, shavings or otherwise. In carrying out the invention, a cartridge case is made of insulating material having a plurality of longitudinal openings in which are placed strips or wires of magnesium or other material, which are thus insulated from one another. Each length of magnesium wire is electrically connected at its rear or inner end with a screw-threaded stud, which extends through the base of the cartridge where it is connected electrically to one end of the conducting wire. All the wires are con-



Electrically-Fired Cartridge.

nected at their opposite ends to a common junction. To explode the cartridge the two poles of an electric battery are connected respectively through the opposite terminals with the two ends of the charge, so that when the circuit is completed the current passes through the charge and vaporizes it. Without going into the question of the practicability of the invention, it is useful to show how inventors are seeking for new ideas.

The Street Railways of Zurich, Switzerland.

United States Consul A. Lieberknecht, of Zurich, Switzerland, sends the following information about the street railways of that city:

Most of the street railways of Zurich are owned by the municipality, and it is only a question of time when the few private lines still holding franchises will also be under the control of the city officials. Municipal ownership of street railways is gaining ground greatly in Europe.

The fare in Zurich is to-day 12.5 centimes (2.5 cents) when buying the tickets in block books, but will within the course of a few years be lowered to 10 centimes (2 cents). It is remarkable that the city can run the street railways so cheaply, considering the expensive and solid way in which the tram lines are constructed and the high price of soft coal, which costs from 33 to 40 francs ($6.37 to $7.72) per ton delivered at the power station.

During the years 1898-1900, the city of Zurich changed its horse-car lines into electric lines with the overhead-trolley system, and also largely extended the mileage. The total length of track is now 40 kilometres (25 miles) and the number of cars 150, of which 40 are trailers. The electric lines have all been constructed by Mr. J. Sigfrid Edström, a Swedish engineer, who received his technical education in the United States. Mr. Edström, upon his arrival in Switzerland, found the electric street-car lines in a very bad state, in consequence of using inferior material. In rebuilding and extending the tramways of Zurich, Mr. Edström did his best to introduce American street-railway material. In buying the rails, however, he found that, owing to difficulties in the ocean transport, the American rails could be had only in lengths of 30 feet, while 60-foot rails were desired. As rails of this length could not be had on the Continent, it was finally decided to use Phœnix & Girder rails (German) of 12 metres (40 feet) length. Without doubt the American manufacturer of steel rails would have a great field for his overproduction if rails of greater length could be shipped across the ocean.

The electric rail-bonds used in Zurich are from a New York firm. One of the new lines has been built with cast-welded joints without any electric bonds. The track itself is laid very securely on heavy stone or concrete foundations. The overhead-trolley wire is generally fastened to the houses, a special sound breaker being used to avoid the transmission of noises into the house. This arrangement is very satisfactory from an æsthetic point of view, as there are very few poles in the streets. Where houses could not be used, the wires are fastened to tubular steel poles of German make, solidly fastened in concrete foundations. Many of these posts also serve as poles for gas or electric lamps.

The cars were built by two Swiss factories, but with American trucks. The street-car motors and controllers are all of American manufacture.

The underground cables, as well as the electric generators, the steam engines and the switchboard, are from Swiss factories. Several machines of American make are used in the repair shop.

Berliner Telephone Patent Declared Invalid.

Judge Brown in the U. S. Circuit Court Decides that Berliner was Antedated by both Bell and Edison in the Invention of a Telephone Transmitter—The Full Decision as Handed Down at Boston.

Judge Arthur L. Brown, of the United States Circuit Court for the district of Massachusetts, decided on February 27 that letters patent No. 463,569, dated November 17, 1891, and granted to Emile Berliner, was invalid and dismissed the complaint of infringement brought by the American Bell Telephone Company, as plaintiff, against the National Telephone Manufacturing Company and the Century Telephone Manufacturing Company, of Boston, as defendants. Although the case has been in the hands of the court for several years and the taking of testimony and depositions was finished some 15 months ago, since which time Judge Brown has had his decision under consideration, interest in the case has not ceased to be active. The decision of the court is regarded as a great victory by the independent telephone field and the declaration of the invalidity of the Berliner patent caused great excitement in telephone circles throughout the United States. When the suit was brought it was understood to be a test case to be followed up vigorously and rapidly if a decision in favor of the American Bell Telephone Company was received. Had the validity of the patent been sustained a severe blow would have been dealt to the independent telephone movement as the financial backing heretofore accorded to that portion of the telephone industry would have been considerably weakened on account of the decision.

Should an appeal be taken from Judge Brown's decision, the United States Circuit Court of Appeals will be called upon to review the case. The decision of the latter court will be final unless the whole matter is ordered before the United States Supreme Court for final revision.

Below will be found Judge Brown's decision as handed down.

RESCRIPT.

BROWN, J. February 27, 1901.

The decree in these cases must be for the defendants.

A.

I find the Berliner patent invalid:

I.

Because, at the date of the application, June 4, 1877, Berliner had not made the invention covered by the patent issued to the American Bell Telephone Company on November 17, 1891.

Berliner's application says, of the instruments shown in the drawing of the patent:

"These simple instruments will reproduce any musical sound uttered in the neighborhood of one of them; but for the reproduction of special sound, such as speech, they are not adapted."

A clear statement of the reasons is given, the statement is repeated; and it is said also, of sound-waves, "nothing of the nature of each wave and the shape of their curves is recorded."

He states that he accomplishes this by apparatus operating to make and break the circuit. His model and drawings, as well as the text of his application, show that he intended to transmit speech by the erroneous method of interrupting the contact of electrodes and breaking the current.

This document stands, in this case, as evidence on the question of invention, exactly as it was written.

It is conclusive evidence that Berliner had not invented and did not intend to apply for a patent for a constant-contact speech transmitter.

The complainant's attempt to show that statements contained in this document were inserted through the mistake of a solicitor's clerk is a failure. I am convinced that this is not true.

I find, as a matter of fact, that Berliner did not, before June 4, 1877, succeed in transmitting speech; but, on the contrary, was convinced by his experiments that speech could not be transmitted by the apparatus of the patent in suit.

I find also that he did not, at that date, intend to describe or claim the apparatus as a speech transmitter.

In view of the original application, the complainant's case can not be established without proof of successful experiments by Berliner. The invention set forth in the patent lay in experiment. In inventions of this class, the true date of conception is the date at which the experiment succeeds.

The complainant concedes that Berliner did not make new apparatus, but reproduced substantially the old Reiss apparatus.

Proofs that the Reiss apparatus, or Berliner's apparatus, or the Morse key, is operative in the hands of experts, does not establish invention by Berliner. He is not entitled, as an inventor of apparatus, to claim whatever may be found to be within its capacity, because his sole claim to invention is based upon an alleged discovery of a new capacity in old apparatus. If he did not discover this, nothing new remains that he did discover or invent. He did not "embody" an invention in apparatus unless he succeeded in making the old apparatus perform Bell's process upon the current. The complainant has not proved that Berliner's apparatus will transmit speech under the conditions existing at Berliner's experiments.

Berliner's caveat of April 14, 1877, does not establish invention, and does not count as a reduction to practice. It proves a project. Later caveats, the application, the record in the Patent Office, and other evidence, show the failure and abandonment of this project.

Complainant's experts agree that what was stated in Berliner's caveat of April 14, 1877, would at that date have been deemed by scientific men impracticable, and that it could not have been predicted upon scientific or theoretical grounds.

In the Telephone cases, 126 U. S., 545, the Supreme Court said, of an experimenter: "It was not until after Bell's success that he found out how to use the Reiss instrument so as to make it transmit speech. Bell taught him what to do to accomplish that purpose." Also, it was said, "It was left for Bell to discover that the failure (of Reiss) was due not to workmanship, but to the principle which was adopted as the basis of what had to be done."

If it was obvious to Berliner, or to persons skilled in the art, upon a reading of Bell's patent, that the Reiss apparatus could perform Bell's process, then the case fails as to invention. If what Berliner wrote in his caveat was obvious without experiment, "Bell taught what to do to accomplish that purpose."

The complainant avoids the defendants' point that Berliner made no invention in using Reiss's old machine by Bell's old method, by evidence that it was not known that such changes as could be effected between solid electrodes would vary the current sufficiently or in the desired proportion. This required discovery through experiment.

The complainant's contention that its case can be established irrespective of experimental results is, therefore, untenable.

To claim that Berliner made an invention because scientific men would have deemed it impracticable to practice Bell's method with solid electrodes, and because it was wholly unknown that the current could thus be made to vary in the proper proportions; and also in the same case to claim that Berliner, in writing his caveat, must, as an inventor, have perceived that his project was necessarily true and that experimental verification was not necessary, is highly inconsistent.

The complainant's case as to invention must rest upon the ground that what was stated in the caveat was not obviously and necessarily true, that experimental verification was necessary; and that Berliner did verify his project by successful experiment, resulting in discovery of facts before unknown.

The proof is strong to the contrary. It is largely documentary and contemporaneous; and is not met by the inconclusive, argumentative and wholly unsupported oral testimony of Berliner given years after the filing of the application. The absence of any corroboration from the numerous persons who are said to have witnessed Berliner's experiments, and the failure to account for the non-production of witnesses, is a strong fact against the complainant.

II.

Because the invention described in the patent is radically different from the invention described in the application.

A comparison of the two documents leaves no doubt on this question.

The application expressly disclaims speech transmission by the instrument of the pat-

ent; and claims as a speech transmitter a double-pin instrument operating to make and break the contact of electrodes.

The patent calls for constant contact of electrodes and an unbroken current; the application for an interrupted contact and a broken current.

The decision of the Supreme Court in the Telephone cases shows the substantial difference between these methods of operating on the electric current.

The original application, by changes purporting to be amendments, has been completely transformed into an application for a distinct invention.

This transformation is of the most remarkable character, and was made after Edison's carbon constant-contact speech transmitter was invented and described in a printed publication.

Such amendment is illegal even if Berliner had made the invention before June 4, 1877.

The amendments made prior to 1880 can not support the patent, as they did not introduce constant contact of electrodes.

If they did, they are illegal, as introducing a different invention.

A constant-contact speech transmitter is first sufficiently described and claimed, if at all, in the rewritten specification of 1880.

The invention had then been in public use for more than two years, *i. e.*, from June, 1878.

There is no legal application to support this patent.

III.

Because the invention was previously patented by Berliner.

Berliner, in 1880, took out a patent which covered the speech transmitter of the patent in suit, applied to its appropriate use in a "system," *i. e.*, with a receiver. Claim 4 of this patent is not in terms or in fact for a combination, since the transmitter is a system part or relative part; and it does not constitute a combination, in the sense in which that term is used in patent law, to put a system part into a system for which it is designed; to put a relative instrument into its intended relation, without invention in so doing. This is but application to appropriate use. The effect of Claim 4 of the 1880 patent was to give a monopoly of this instrument, applied to its appropriate use without additional invention in making this application. By granting the patent of 1880, the commissioner exhausted his power to issue a second patent whereby the patentee could control all use of this instrument as a transmitter. Having been protected for 17 years in the use of this transmitter with one receiver, Berliner was not entitled to further protection for use with any and all receivers.

I agree with the conclusion of Judge Carpenter on this point, in United States *vs.* American Bell Telephone Company, 65 Fed. Rep., 86.

IV.

Because Edison was the prior inventor.

Berliner's amendments must bear date as of the date of filing.

August 8, 1877, is the earliest date of amendment affecting this controversy.

Berliner's amended application is anticipated by Edison's application of July 20, 1877, and by the Philadelphia *Press* article of July 9, 1877.

The burden of proof is upon the complainants to anticipate Edison. They can not sustain it.

Assuming Berliner's application to date as of June 4, 1877, he is anticipated by Edison's application of April 27, 1877.

One form of apparatus therein described is substantially the Berliner apparatus, operating in the same way.

B.

Claims 1 and 2 in suit are invalid because anticipated by Bell's patent and Bell's liquid transmitter.

Bell was a prior inventor of a transmitter that operated upon a battery current by changes of an electrical contact. Its mode of operation was by constant but variable contact of electrodes. Variable pressure upon the diaphragm and variable pressure of one electrode upon another are invariable and necessary accompaniments of its operation.

As Bell's liquid transmitter has two aspects or features invariably accompanying each other, and novel over the magneto instrument, either will serve for a name or description that will distinguish the liquid transmitter from the magneto transmitter.

We may call the Bell liquid transmitter a "constant but variable contact transmitter" or a "variable-pressure transmitter," or we may say that the mode of operation is by "variable contact" or by "variable pressure." These names are interchangeable.

They are of no value, however, in pointing out differences between the different types of constant-contact transmitters before us in this case, because they name only features common to all, and do not state a distinctive difference.

The claims of the patent cover all transmitters having variable pressure between electrodes.

They therefore seek to appropriate Bell's invention under a new form of words.

The claims, when read according to their natural signification, undoubtedly include Bell's liquid transmitter, and are invalid for excessive breadth.

They can not be saved by making an arbitrary exception of Bell's liquid transmitter as specific apparatus, because that would still leave Berliner claiming all other transmitters possessing Bell's features of variable contact and variable pressure between electrodes, which are now public property.

This is not a mere verbal criticism of the claims; for experts and counsel, by the use of language similar to that of the claims, credit to Berliner, and seek to cover by his patent, what was in fact the invention of Bell.

Attributing to Berliner the invention of a mode of operation or process, to wit, "variable pressure, and apparatus characterized by this mode of operation, they explain its novelty by ignoring Bell's liquid transmitter, and by reverting to Reiss, they thus show a novelty over Reiss, to wit, the "variable-pressure operation," as distinguished from the make and break operation. In other words, they claim for Berliner a new "electrical mode of operation" which is in fact Bell's; and also a new mode of treating the circuit, *i. e.*, varying without interrupting it, which is also Bell's.

This is accomplished with some degree of plausibility by using a new term, *i. e.*, variable-pressure operation, to signify an old thing, *i. e.*, the varying-contact operation.

When we start from Bell, as we must, in the search for novelty, and not from Reiss as the complainant does, we find that the language of the claims, read in the light of the prior art, shows nothing novel over Bell.

C.

Claims 1 and 2 are anticipated by Edison.

These claims are of excessive breadth for the further reason that they include various devices of Edison which, like Bell's liquid transmitter, employ a battery current and a variable contact of electrodes, and variable pressure. Edison's devices of February 9 and April 1, 1877, anticipate these claims.

The complainant asserts that these transmitters differ essentially from Berliner's, and therefore admits that Berliner has no right to include them; but nevertheless the broad, general language of the claims covers them. A limitation to solid electrodes does not save the claims.

By claiming "variable pressure" of electrodes as a method or principle, the complainant has attempted to monopolize a feature common to many constant-contact transmitters, and thus to discourage and hamper further invention in the same line of industry. The claims are plain. They cover all forms of variable-contact transmitters before us in this case.

I am of the opinion that they are void, and can not be saved by the specification.

These claims are now said by counsel to express accurately and happily Berliner's real invention. They do, in fact, represent the substance of the complainant's main argument.

The complainant also claims for Berliner's invention in the use of the minute force of a sound-wave to vary pressure between electrodes, and invention in the discovery that accompanying variations of pressure were corresponding variations of current.

This is in the Bell patent as well as in Bell's liquid transmitter, and in various devices of Edison.

The complainant is certainly not entitled to claim as a novelty the utilization of minute forces, after the Bell patent and Bell's liquid transmitter, and in view of the contention that Edison intended to compress a mass of plumbago thereby.

Berliner borrowed his apparatus for "transmitting the impression of agitated air" bodily from Bell's second patent.

As variations of current are proportional to variations of pressure at the diaphragm in all transmitters, it is not remarkable that they are also proportional to variations of pressure at the place in the circuit where the change of contact occurs and where the force exerted at the diaphragm is expended upon the circuit.

It is the principle of Bell's magneto instrument and of his variable-contact transmitter, that the current shall vary proportionally to the pressure at the diaphragm.

It is a principle of the variable-resistance method, that the resistance shall vary by pressure exerted upon the circuit and proportionally thereto.

In the liquid transmitter is the principle that the current shall vary proportionally to the pressure at the diaphragm, and also proportionally to the pressure between electrodes; and also that, as the pressure on the diaphragm and between electrodes is weakened, the current becomes less intense; as it is strengthened, more intense. This was also in Edison, before Berliner.

We are not dealing with claims carelessly drawn by an ignorant inventor; but with the phraseology of experts, framed more than two years after public use of the invention, with the intention of asserting that Berliner was the originator of very broad principles that control the practical art of telephony.

Those principles are Bell's.

D.

Claim 1 for a method is invalid.

The patent discloses nothing patentable as an art, method, or mode of operation.

The method is "by causing the sound-waves to vary the pressure," "so as to strengthen and weaken the contact."

Apparatus is required, *i. e.*, electrodes in constant contact.

The "causing" is accomplished by placing the apparatus where there are sound-waves. This is not patentable as an art or method.

Producing sound-waves is no part of the method whereby existing sound-waves are caused to vary pressure. The patent covers no art or skill required in keeping the electrodes in constant contact.

The patent shows a screw by which this can be done. It appears that an equivalent means is in using a low tone of voice to avoid destroying the contact. This is not an art or method; or, if so, not that covered by this patent. If the invention is required to keep the electrodes in constant contact, or to put transition resistance into the circuit, the patent is bad, since it leaves this to be found out by experiment.

Producing sound-waves appropriate to particular forms of apparatus is not the method whereby existing sound-waves are caused to vary pressure between the electrodes, and should not be confused therewith. The force utilized, and the process performed upon the current, *i. e.*, causing undulations of a particular form, are both in Bell.

(*Concluded on page 287.*)

THE TELEPHONE IN STEAM RAILROAD SERVICE.*

BY E. A. CHENERY.

This paper was prepared to answer, so far as possible, the question: "Can the movement of trains and the handling of the general business of a railroad company be facilitated and improved by the use of a telephone system that places all interested in direct communication, such telephone system enabling connections to be made at any point on the line by trainmen of disabled trains between stations, and also affording telephonic communications between all officers, agents, section foremen and others on each division and between the general and divisional officers of the entire railroad system, such system to be established and operated at less cost than the present system of telephonic communication?"

Within the past 10 years the telephone situation, so far as it has had to do with the handling of the general business of a railroad, has undergone somewhat of a revolution, and while the limit of its usefulness has not by any means been reached, such a stride is being made as serves to startle those who are not directly in the van of progress.

Experiments have been made within the past few years in the direction of utilizing jointly, telegraph wires for telephonic purposes, and this has reached such a stage as to warrant the statement that, within certain limits, this can and is being done. The writer, early in this year, carried on a conversation by telephone over an iron wire between Chicago and Aurora, a distance of 37 miles, which was being used at the time as a telegraph wire, and the slight noise due to induction was far from being annoying.

Within the past few months several of the larger railroads have been considering the advisability of substituting the telephone for the transmission of orders in the movement of trains, and that an advance in this method will be made in the near future there is not the question of a doubt.

Many of the members of this club are familiar with the crude system in vogue at certain large terminal points where communication between the managing officers and their subordinates is conducted by messenger service, by telegraph or over a so-called telephone line constructed out of bits of wire left from a discarded telegraph line, and it is with particular reference to such inadequate facilities that this answer to the above question is made the basis.

* A paper read before the St. Louis Railway Club.

There is probably not a railroad in St. Louis, or its sister city across the river (and I might say the condition applies equally as well to other large terminals), that is not at times hampered in an attempt to transact business without delay, because it has not the means to communicate between its directing and its working employés. Possibly all such roads have public telephones in some of their general offices, the office of their contracting agent, their local freight agent and have private lines running between and connecting their local agent and certain yard clerks, all of which, after a fashion, afford certain channels to dispose of important matters.

It is possible for a traveler starting from St. Louis to reach New York going *via* New Orleans or Jacksonville, but to a person having important engagements, that route is not likely to be chosen when there are more direct lines open. This is not intended to advertise any certain trunk line, but rather to call attention to quickest methods, and this is the purpose of and for which the telephone has the greatest claim on the business interests of to-day.

The old plan, and it is still in use by many roads, was to build and equip a private line running between the contracting agent and the local freight. Then other lines from the local freight to various yard offices, adding additional telephones to the most convenient line as new offices were opened, and the results inevitably were lines carrying from six to ten busy stations full of annoyances and lack of privacy such a system only affords. As the business grew it was impossible to conduct it with any degree of satisfaction, for the reason that where so many offices were on one line the service was of necessity subject to censure because some one would often leave the receiver off in searching for information, and the other several offices would be tied up as completely as though the line had broken.

A telephone service, to give the best results possible, should be one connecting every office that may have business with another. It should not be the policy of the company to install only as few instruments as they actually could get along with, but rather to provide sufficient equipment of this character to take care of every possible condition arising in the daily routine of business.

The freight office, as a starter, should not be so limited in its telephone facilities as to invite censure from the busy merchant, for this is surely the result when he, after repeated efforts to raise the office named, each time is given the busy signal. Possibly your competitor's telephone at the time happens to be resting, and the merchant, in his exasperation, cultivates a new friend.

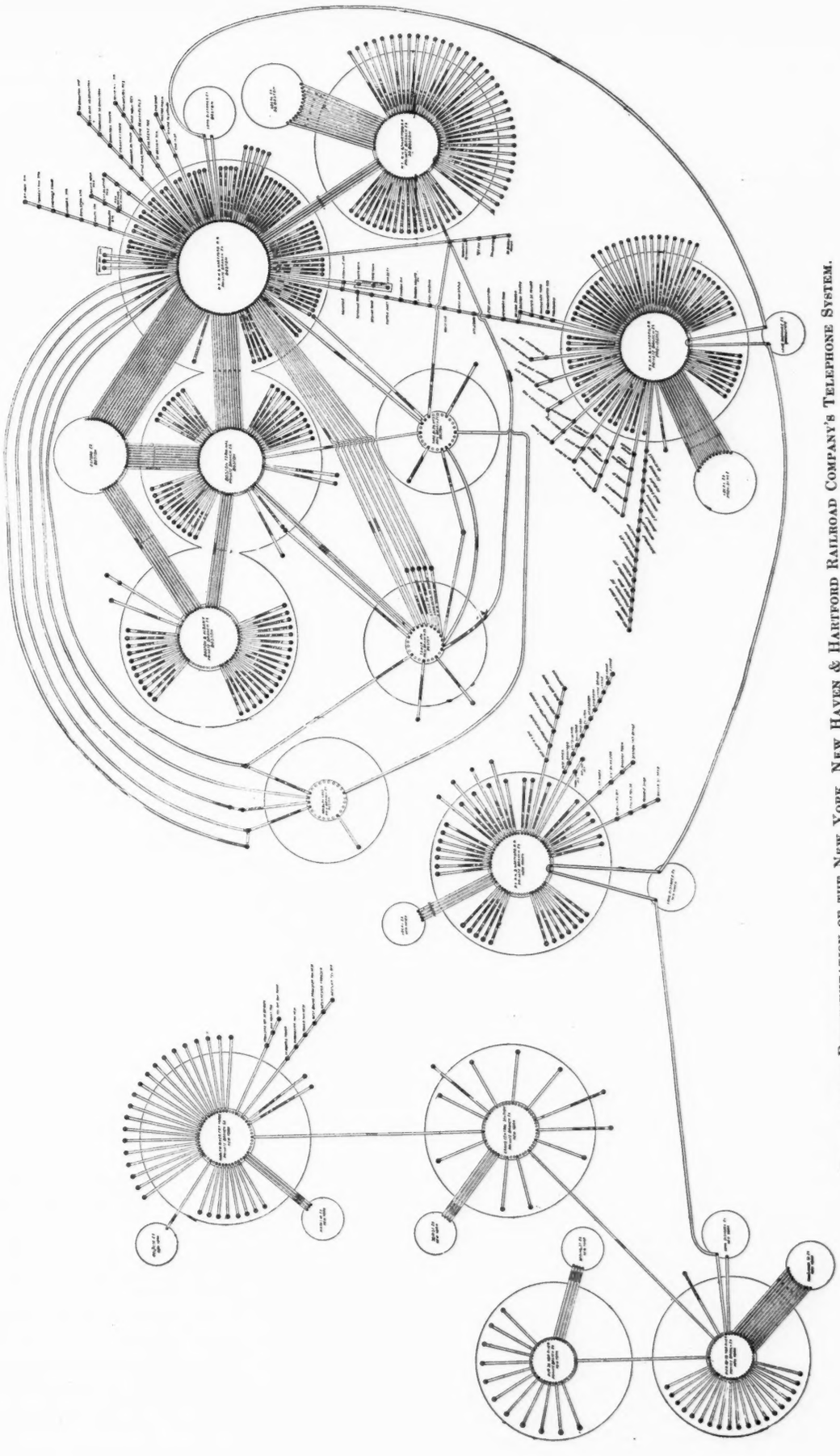
The contracting agent, like the local freight, should also be able to render as satisfactory service by telephone as though a personal call was made at the office, for the busy man has no time to squander without reason, and here again should ample facilities be provided.

The contracting agent and the local freight, in their dealing with the public, must now be equipped with information and data which, if not directly at hand, is obtainable on short notice. To insure this, the telephone service must be extended to the various offices, junction points and yards where are located yard clerks, yard masters and others interested in freight movements.

Other departments must not be forgotten in the provision for rapid communication. Telephones should be in the roundhouse, in the shops, office of the car inspector, the telegraph office, yard master's offices and, if the service to be covered includes passenger stations, the station master, ticket and baggage agent, information bureau and other such offices must be brought into close touch.

The new plan contemplates a separate exchange for the exclusive care of the class of business I have referred to. This exchange to be centrally located, with lines running to the various offices in the territory, enabling any one office to communicate with any other with scarcely an instant's loss of time. Such a plan is all right so far as it goes, but it is yet too narrow in its scope. At terminal points where the interchange of freight is heavy between any two or more roads there should be provided such facilities as will enable the representatives of one road to communicate with those of another, and the telephone offers a solution if its fullest use is obtained. Out of a number of instances, I might call attention to the following where such a system would be of value if it extended to all roads.

A delivery of 20 cars is made by a road, we will call, for short, the N. B. Railway, to the yards of the U. T. D. Railway for movement on a fast freight due to leave shortly after the cars reach the latter road's yard. Two of these cars are found to be unaccompanied by way-bills, and in the natural order of things they would be switched out for a later train, while the remaining number go on. If proper facilities obtained, the yard clerk would be notified of the shortage, and the bills



DIAGRAMMATIC REPRESENTATION OF THE NEW YORK, NEW HAVEN & HARTFORD RAILROAD COMPANY'S TELEPHONE SYSTEM.

either hurried over by messenger or copies telephoned, in order that the cars might proceed without suffering a delay. Not only would unnecessary switching be prevented in such a case, but the claim department would be saved another bunch of correspondence.

Take another case, and one that has grown to be a daily occurrence. The elevator representatives, about the closing hour, place their orders for cars for tomorrow's loading and go home, expecting to find the order filled when they come around in the morning. In order that the empties may be gathered up, your car clerk, in direct touch with all yards, places his orders to cover such cars as are in his possession, and then makes his requests on connecting roads for such cars as are needed. These orders are now handled between one road and another usually by telegraph, and it often occurs that they are left hanging on the telegraph table hook all night because of lack of telegraph facilities, and reach their destination too late to accomplish the original purpose. It is obvious that if your car clerk was able to place his orders direct with the car clerk of your connection instead of through the hands of at least two operators and messengers between them and the operating desks, the results would be different, and your clerk would go home knowing that his wants, at least, were known by those concerned.

Way-bill corrections—and this class of telegrams has grown with the increased business—might better be handled by telephone than by telegraph, with a positive understanding between the parties interested.

We all know of cases of a message started to a connection directing the changing of way-bill, either its destination, weight, rate or amount, and later on found the message had become lost, strayed or stolen, or, more likely, "bulled," through reading of bad copy, or because of being handled by "ham" operators, and found afterwards the freight to which the message referred had been delivered, and the correction could not then be made.

The writer claims that the amount of telegraphing between agents of connecting lines in the same city is beyond all reason or warrant. It is not only extravagantly expensive but often unsatisfactory, and burdens the telegraph wires to the detriment of other important work that the telegraph field is presumed to cover.

The ideal service, then, is the exchange. There is perhaps no large city in the United States so favorably situated as St. Louis for the carrying out of such a plan as I would suggest, from the fact that the roads all are located close together. We will take for instance East St. Louis, where the freight offices of 12 roads are located on the river front within a radius of one mile. Locate an exchange at the east pier of the Eads Bridge, or some point in the immediate neighborhood which would be about midway between the roads named. Into this exchange run wires from telephones in each of these freight offices and such yard offices as are required.

On the west side of the river possibly two exchanges may be needed. One in the northern part and another in the southern part of the city, each taking care of the district in its immediate neighborhood. Having these railroad exchanges and connecting them with each other by trunk lines, we have the ideal system, and once adopted, no one will ever recommend displacing it by the old system.

To better illustrate the matter I take the liberty of calling your attention to a blue print showing the telephone system of the New York, New Haven & Hartford Railroad. A perusal of this plan will show one exchange wherein something like 50 stations in the building and quite as many more outside are cared for. Another exchange takes care of the station departments, ticket agent, baggage rooms, gates, etc., while other exchanges are located in the Boston & Albany office, South Boston, and at certain towers, etc. Nor does the system stop with Boston. They have exchanges at Providence, New Haven, and several in New York, and are connected by long-distance wires with all stations, Boston to New York, and with trunk lines between each exchange and the local city exchange of the city through which their road runs.

The general manager or other officer in his office with this perfect system is enabled to transact business with any general or subordinate officer at any of the stations the entire length of the road.

The Pennsylvania system has also a system of telephone exchanges between New York and Pittsburgh, all of which are connected with each other by trunk lines.

To be up to date, a great deal of the work now done by telegraph must hereafter be done by telephone, and railroad companies at large points must have better facilities than they have heretofore had.

One of the most recent incorporations in automobile circles is that of the Electric Cab Company, of Toronto, Canada, which has been chartered with a capital stock of $50,000 to establish electric cab service in that city.

Automobiles

A bill recently introduced in the Legislature at Albany, N. Y., by Senator Platt to allow gasolene motor wheels to be carried on ferryboats has been favorably reported to the Senate by the Committee on Commerce. An amendment, recommended by the Committee, makes their transportation discretionary with the owner, master or agent of the vessel. Under the existing law their transportation by ferryboats is absolutely prohibited.

The Chicago authorities have issued 378 automobile licenses up to date, for which 226 are for electric machines, 60 for gasolene, and the balance for steam vehicles. Although there have been a number of runaways and accidents since the automobile appeared on the street, not a single death has resulted from any of them and only 12 have occurred in which any one was actually injured. Every one that has taken a license will make a detailed report to the city electrician of accidents, in order that that official may keep a record of such matters.

French justice for automobilists is sometimes unusual, as may be shown by the case of M. Bardin, who was recently brought before a suburban magistrate of Paris for fast driving. The park policeman who arrested him in the Bois de Boulogne swore that the prisoner had passed through the park at the rate of 34 seconds per kilometre. The prisoner pleaded in vain that such a speed was impossible, implying, as it would, 114 kilometres per hour. The policeman was obstinate, claiming that he had timed the offender, watch in hand, and M. Bardin was sentenced to pay a fine of 10 francs.

A gasolene automobile in Philadelphia, being improperly handled, recently became unmanageable and the gasolene was ignited. The driver lost his head and drove the machine at full speed through the streets in a mass of flames. At last, having become thoroughly disconcerted, he ran the machine into a lamp post on which was a fire-alarm box. The driver was thrown 30 feet away and the lamp post and fire-alarm box were wrecked. This had an unusual result, as a moment later the fire engines and hook and ladder companies came tearing down the street looking for the fire. They immediately extinguished the flaming gasolene, and the driver, after having his bruises attended, got a team of horses and hauled the useless machine home.

BERLINER TELEPHONE PATENT DECLARED INVALID.

(*Concluded from page 283.*)

The method of Claim 1 is practiced solely by a machine, and is merely the *modus operandi* of a machine; and is not patentable as an abstraction apart from a machine.

If there was involved a discovery of the value of minute variations of contact in changing a current, this led merely to the construction of apparatus, and not to a new art or method.

Moreover, Claim 1 is invalid by two years' public use.

E.

Assuming that the specification discloses an invention, and that by limitation Claim 2 can be saved, the patent nevertheless is limited to the structure therein described, and so limited that the defendants do not infringe.

The patent does not disclose or suggest any material other than metal for the second electrode. Berliner's experiments were solely with metallic electrodes. He did not, as a matter of fact, make any investigations in consequence of which he was entitled to assert a general truth concerning all solid electrodes.

It is not proven that metallic electrodes are generally suitable for practical use in a speech transmitter.

To save the patent by limiting it to the apparatus there shown would not avail the complainant. The defendants' transmitters having carbon electrodes are, as apparatus, distinct inventions.

The carbon electrode was the invention of Edison; it was not an equivalent for the metal electrode of Berliner.

The complainant seeks to hold the defendants' transmitters as infringements by comparing them as embodiments of a principle, art, process or method, discovered or invented by Berliner. I am of the opinion that it has not succeeded.

The variable-pressure principle affords no basis for a distinction between Berliner's device and three variable-pressure constant-contact transmitters which preceded it, two having solid electrodes.

This generalization which covers the defendants also covers so much of the prior art that the complainant is anticipated if it stands upon it. Distinctions between changes in intimacy of contact and of area of contact, and changes of mass or molecular condition following pressure of electrodes in contact, are distinctions as to apparatus, not as to principles; and these distinctions are not satisfactorily established.

The transmitters of Bell, Edison and Berliner agree in this, that each is capable of producing electrical undulations similar in form to sound-waves, and of transmitting speech. Upon the evidence as it stands in this case, this must be assigned to the general feature which is common to all variations of physical contact. I do not think that anything more than distinctions in the kinds of contact has been shown.

A patentee is entitled to take the position that, as an experimenter, he produced practical apparatus, or found that old apparatus could be applied to a novel and non-analogous use. He may stand on his legal right to refuse to enter upon a discussion of the laws of nature or scientific principles involved, and say, I claim, as a novel and useful thing, my apparatus. This apparatus exhibits my invention, and proves by example its character. The complainant does not submit to have the invention compared with others as to its practical efficiency in the practical art. It undertakes to claim something very much broader than what is exhibited in the apparatus of the patent.

The patentee first takes the position that Berliner said, I have found that, when electrodes are pressed together more or less by the minute pressure of sound-waves, the current increases and decreases proportionally; but two inventors before Berliner found this out.

The patentee then says, I have found that this is the case with two solid electrodes; but Edison had found this out before.

The complainant replies, But these inventions change the area of contact, and the mass or molecular condition of the second electrode, which is a radically different method from mine, though probably these changes may occur in my transmitter to some extent. I do not know what is the reason of the change of current in my transmitter. The defendants say that all these instruments agree broadly in this, that as changes of physical contact occur changes of current occur. They all produce electrical undulations similar in form to sound-waves. They are, therefore, members of a class, to be compared merely in respect to the manner in which they respectively perform their functions and according to what they have contributed to the practical art.

The complainant makes a final attempt to lift Berliner's invention out of a subordinate position in the class of constant-contact transmitters; and attempts to give an account of the reason for the change of current in Berliner's instrument, saying Berliner's instrument operates by varying transition resistance (that is, the resistance of imperfect contact, which varies as the contact is weakened and strengthened, but this does not appear to be anything more than singling out for description another aspect of what occurs in all cases when a contact changes. The resistance is due to discontinuity; to change the discontinuity, we must change the continuity; changing the continuity is merely changing the contact.

This is a novel form of words, but it does not distinguish Berliner's transmitter broadly from other transmitters. But it is said the other transmitters show but little or no trace of microphonic action when they transmit speech.

The final distinction is as to the character of the tone produced by the different transmitters.

Testing the merit of Berliner's invention by his advance in the art, by the advance made with metallic electrodes, we see that it is very slight. Metallic electrodes have never come into commercial use. The Berliner instrument made no advance upon Bell's magneto instrument. It is not proven to be superior to the instruments of Edison having solid electrodes.

The Berliner patent, or Berliner's caveat, does not contain any suggestion of the thought that was the basis of the invention of the carbon transmitter. Edison preceded Berliner in the transmission of speech. The carbon transmitter was an experimental invention of a very high order of merit. It would be contrary to common sense to permit this invention to be subordinated to the invention of Berliner's patent.

If Berliner made a discovery, it was simply a discovery that such minute variations of contact as could be produced between metallic electrodes would transmit speech to a limited extent. If Berliner or others have succeeded in finding that metallic electrodes can be balanced so delicately that they will transmit speech, this is not a discovery that is embodied in the defendants' transmitters.

Edison, thinking of using such variations of contact, tried them before Berliner, and found them useless. He set about the problem of finding a contact material that was adapted to the preservation of contact, and adapted to produce a wide range of variations in the current. The advance in the art is due to what he discovered.

If scientific men, by patient industry, succeed in stating some aspect or some peculiarity in which Berliner's and Edison's transmitters agree, this is not such a practical test of identity as the patent law requires. The only practical test of identity in this case is by comparing instruments of the Berliner type and instruments of the Edison type in respect to practical efficiency.

The attempt to expand Berliner's unsuccessful experiments and caveat, first, into an invention, and next, into a broad claim for an art, method, principle or process, exhibits a remarkable degree of ingenuity; but is not convincing.

Mere changes of a current, not resulting in speech, do not make Bell's speaking current. A statement in writing that an instrument will produce any and all changes of current is not the equivalent of finding by experiment that it will do so. Variable pressure between electrodes in constant contact is not Berliner's novelty. It is not a sufficient account of a means of transmitting speech. Varying transition resistance is varying contact. The distinctions are between apparatus, not between methods.

The discovery that minute variations of contact between metallic electrodes will transmit speech is not the discovery embodied in the defendants' transmitters.

I am of the opinion that the defendants' transmitters are an invention substantially distinct from that disclosed in the Berliner patent; that the conception by Edison of the use of carbon for speech transmission preceded Berliner's conception of the use of solid, metallic electrodes; that, from his first conception, Edison diligently proceeded upon a line of experiments that led to an invention of remarkable character, which borrows nothing from Berliner, has no substantial resemblance to what is shown in the Berliner patent, and can not be identified with it by any ingenious use of language. The defendants owe nothing to Berliner.

By this rescript I announce my decision; but will file, as soon as may be, a printed opinion, in which will be considered in further detail the questions of law and fact arising in this case.

The bill will be dismissed, and a draft decree may be presented accordingly.

A British Electrical Contractors' Association.

A movement is on foot in London to establish a national electrical contractors' association similar to the one in existence in this country. At a recent meeting in London representatives were present from electrical contracting firms in numerous British cities, and a provisional committee was appointed to draw up a preliminary constitution and set of rules governing the conduct of the proposed association. American electrical men interested in this movement may obtain information from Mr. Thomas Guthrie, 46 Queen Victoria street, London, E. C.

The Considerate Editor.

[*From the Galveston News*]

A subscriber to a certain paper died and left 14 years of subscriptions unpaid. The editor appeared at the grave as the lid was being screwed down for the last time and put in a linen duster, a thermometer, a palm-leaf fan and a receipt for making ice. Editors, as a rule, are not prosperous, but they are kindhearted and considerate.

Death of Dr. M. G. Smith.

Dr. Mayo G. Smith, who was associated with Morse in constructing the first telegraph line between Washington and Baltimore, died at Colorado Springs, Colo., on February 20. He was 85 years old.

Electric Railways

Ironton and Portsmouth, Ohio, will probably be connected by an electric railroad during the coming Summer.

Important extensions are planned for the Buffalo & Hamburg, N. Y., trolley, commonly known as the "Allen Line."

A franchise has been granted to the Kalamazoo Valley Traction Company for an electric railway through the village of Paw Paw, Mich.

Automatic electric block signals are being installed on the lines of the Central Railroad of New Jersey, between Bound Brook and Whitehaven.

A large power plant will soon be constructed at Halsted street and Thirty-eighth court by the Chicago, Ill., Street Railway Company. The expenditure involved is approximately estimated at $500,000.

An electric line in the San Gabriel Valley, Cal., to connect Pasadena and Duarte is projected, and the Californians are said to desire a direct line throughout the valley to Los Angeles *via* San Gabriel and Alhambra.

Reports from Elgin, Ill., state that the Lynn City, Carpenter Hill & Aurora Railway Company, operating electric lines up and down Fox River, was recently sold to M. J. Mandelbaum, of Cleveland, Ohio, for $550,000.

Fire broke out during the night recently in the power-house of the Omaha, Neb., Street Railway Company, entirely destroying the interior fittings of the building, machinery and cars. The total loss was about $200,000.

Owing to the difficulties of operating that company through a foreign corporation, a plan is said to have been formulated to liquidate the Worcester Traction Company (of New Jersey), which owns the Worcester Consolidated Street Railway Company, of Massachusetts.

Manager A. A. Anderson, of the Mahoning Valley Street Railway Company, of Ohio, recently stated that the improvements soon to be made to the company's lines would include a large power-house of sufficient capacity to operate the entire system from Warren to Lowellville.

A company to build an electric street railway from White Plains, N. Y., to Kensico station, three miles north, is being agitated in the former town. If built, the line will be practically an extension of the Tarrytown, White Plains & Mamaroneck road.

Texas advices state that the prospects for two interurban lines to connect Fort Worth and Dallas during the coming year are good. Mr. J. B. Coffinberry, of Texas, one of the promoters of the road, recently stated that he hoped to begin work within a very short time.

Plans for the new Flatbush depot of the Brooklyn, N. Y., Rapid Transit Company in place of the old one recently burned down will soon be completed. The upper part of the new building will be laid out as up-to-date clubrooms for the motormen and conductors.

A plant is being built by the Chagrin Falls & Eastern Railroad just beyond the city limits of Cleveland, Ohio, for storage batteries. The batteries will be installed for the purpose of increasing the speed of the cars in a manner very similar to that explained in a recent number of the ELECTRICAL REVIEW.

A dummy electric railway line is said to be projected for Midlothian, Ill., and the charter of the Midlothian & Blue Island Railroad Company was recently filed at the Recorder's office, the capital stock being given at $50,000. The incorporators of the road are J. C. Shedd, E. C. Potter and E. A. Turner.

The directors of the Metropolitan Street Railway Company, of Kansas City, Mo., are preparing to spend $3,000,000 this year in improving their lines. Important extensions will be built, and the new lines within the city will be constructed as follows: On Indiana avenue, from Eighteenth street to Thirty-first street; on Springfield avenue, from Indiana avenue to Main street; on Walnut street, from Thirteenth street to Twentieth street; the Baltimore avenue line, on Baltimore avenue from Ninth to Fourteenth and on Fourteenth from Baltimore to Broadway.

The Railroad Commission of the state of New York recently heard the arguments of both sides in the matter of the Buffalo, Niagara Falls & Rochester Electric Railway Company, which desires to build and equip an electric railroad for freight traffic. The company's intention is to run trains of not less than 20 cars in busy times for the accommodation of freight, and the motors specified are said to be of sufficient strength to haul a loaded train of that length at a speed of 20 miles an hour. As soon as the franchise is granted the company will file an adequate bond and commence the construction of the road.

Reports from Columbus, Ohio, say that the details for the purchase of the Columbus, Buckeye Lake & Newark Traction Company are completed. The line was incorporated about a year ago for $1,000,000 by General H. A. Warner, of Marietta; Pomerene Brothers, of Coshocton, and Michael Spellacy and others of Columbus. The road will run from Newark to Columbus, and it is said that the new owners, whose names are not given, will be in harmony with the Columbus, London & Springfield road. A consolidation of the two lines is hinted at as a possibility of the near future.

A Chicago, Ill., newspaper reports that Thomas F. Ryan, of New York, has purchased the control of the Union Elevated Railroad, or Loop, which brings all the other elevated railroads into the heart of the city. It is further claimed that he has also secured control of the Lake Street Elevated, sufficient stock in the Northwestern Elevated to insure control of that road, and also the stock owned by Blair & Company, of New York, and John J. Mitchell, of Chicago. He has also secured control of the Union Traction Company. The purchase of the various properties seems to indicate a general consolidation of the lines of the Chicago Union Traction Company and the elevated railroads. If the purchase has been made, the seller is Charles T. Yerkes, as it is only from him that sufficient stock to control these properties could have been bought.

At a recent meeting of the representatives of a large proportion of the street railway and interurban electric companies of Michigan, an association was formed which will be known as the Michigan Interurban and Street Railway Association. The officers of the new company are: President, W. L. Jenks, of the Port Huron Street Railway Company; vice-president, J. D. Hawks, of the Detroit & Ann Arbor Interurban Railway; secretary and treasurer, B. S. Hanchett, Jr., of the Grand Rapids Railway Company. The new association is said to be the outgrowth of an old organization of the street railway companies which has been in existence for some years, but has hitherto remained inactive. Its object, as stated by the articles of the association, is said to be the acquisition of experimental, statistical and scientific knowledge relating to the construction, equipment and operation of street railways, and its diffusion among the members of the association with a view to increasing the accommodation of passengers, improving the service and reducing the cost of operation.

Nearly $2,000,000 are to be spent on improving the trolley lines of the Lehigh Valley Traction Company in the Slate Belt region, in Pennsylvania, which will be probably extended to Portland and Stroudsburg. It is said that when these improvements are completed the line will be the greatest system of the kind in the world.

Figures deduced by the head of the statistical department of the Bureau of Railways of the state of Pennsylvania show that the income of the 94 street railway companies operating in that state during the fiscal year which ended June 30, 1900, was $24,477,181, while the taxes paid during that year by those companies aggregated $1,579,284.

An Unusual Electric Railway Accident.

An order issued by the Health Department of Richmond Borough, N. Y., to the Midland Electric Company, of Staten Island, provides for a shelter at the St. George terminal of the road, which is one of the coldest spots on the entire island. The shelter has been greatly needed for a long time and will be appreciated by the patrons of the road, as it is frequently necessary to wait there for some time to get the right car.

A large power-house will soon be built in South Brooklyn, N. Y., for the Brooklyn Rapid Transit Company, to supplement the five power plants now in service. Six engines with 40,000 horse-power will be installed at a cost of about $3,000,000. At the present time the five plants in service furnish an aggregate of nearly 36,000 horse-power, which, before the Ridgewood power-house was destroyed by fire, was 38,250 horse-power.

Before the end of the present year Richmond, Va., will have a new electric line to run from the city limits to Green's Mill Pond, a distance of three and one-half miles. The road will be built by the West Hampton Park Railway Company under the direction of Mr. John C. Robertson. At the terminal of the road a park will be laid out and arrangements made for bathing, boating, fishing and similar attractions for the amusement of the public.

Within a twelvemonth passengers of the Consolidated Traction Company, of Pittsburgh, Pa., will be enabled to ride comfortably in the cars of that corporation, as it has been determined by the company to banish the coal stoves now in use and install the latest type of electric heaters in all the cars. At the present time 50 of the cars have been equipped with these heaters, and the experiment has proven such a success that it has been determined to equip the entire rolling stock of the line with them.

Ex-Congressman A. J. Hunter and United States Marshal Hitch, of Illinois, are said to be at the head of a syndicate of Edgar County capitalists to construct an electric road from Paris, Ill., to Clinton, Ind. The road will be 30 miles long, and will cost about $250,000. Its object is to open up the rich coal fields and populous farming country in that region, which at present have no railway facilities. A company of Clinton capitalists will complete the system from the Indiana line to their city.

An Unusual Electric Railway Accident.

An electric street car, west-bound, on the Dayton division of the Bellevue & Dayton, Ky., line, jumped the tracks one morning recently, tore down a heavy fence on the north side of the road, near the boundary line between Newport and Bellevue, and plunged with its passengers over the embankment, landing in Taylor's Creek, 50 feet below. That there was no loss of life to the 24 passengers in the car is unexplainable, but there were many injured, some of them so seriously that they will probably die. The car, moving at a high rate of speed on Fairfield avenue, in Bellevue, leaped the track when opposite the horseshoe and before the passengers had time to become frightened they were all hurled into the ditch below. Of all those in the car the motorman alone had a chance to escape but he, in the hope of stopping his car, stuck heroically to his post, receiving injuries which will probably prove fatal, as an artery in his neck was severed and his jaw torn from its socket. As soon as the injured had been removed from the wreck the street car company sent heavy windlasses to the place and piece by piece the car was pulled out of the ditch, most of the work being done under the personal supervision of President Ernst. The car did not even turn completely over and aside from several panes of glass being broken did not look much the worse for its long fall. It was impossible to remove it entire, so the workmen turned it over on its side to save the motors first. It was then seen that the heavy ironwork under the car was almost completely demolished. It struck with such force that the wheels and other parts of the truck were driven through the floor. The speed of the car seems to have been high, but not faster than usual, and theories of the causes of the accident are many. In speaking of the affair, President Ernst stated that it was the most remarkable street car accident that he had ever heard of in all his experience. He also stated that he had seen over a dozen of the passengers who were in the wrecked car but had been unable to find one who could give a clue as to how it happened. The accompanying illustration presents a view of the car just after the accident, and is presented by courtesy of the Cincinnati *Commercial Tribune*.

Recent reports from Boston stated that the Elkins-Widener-Whitney syndicate is preparing to establish a through trolley line from Boston to New York, to compete with the New York, New Haven & Hartford Railroad Company.

Electric Lighting

An electric light plant will soon be installed by Hamilton County, Tenn.

The electric lighting plant of Perham, Minn., is soon to be enlarged, and the contract has been let for $39,000.

Von Bolckow & Company, of England, are installing an electric lighting and power plant in their Eston Steel Works, at a cost of £40,000.

It is reported that W. W. Hopkins and R. E. McClenahan have been appointed receivers for the Port Deposit, Md., Electric Light Company.

The authorities of Cambridge City, Ind., have let the contract for a new electric plant, which will operate in connection with the waterworks at a cost of about $14,000.

An electric lighting plant is said to be planned by the village authorities of Absecom, N. J. If built it will be established during the year and in operation before the Fall.

An electric plant is being considered for lighting the County Infirmary, at Columbus, Ohio. If erected the new plant will furnish from 600 to 700 lights and will cost between $3,500 and $3,600.

The Consumers' Electric Light Company, of Haddonfield, N. J., has been organized to compete with the South Jersey Gas, Electric and Traction Company for lighting franchises in the town named.

The project for the construction and maintenance of a private electric light plant in Findlay, Ohio, is receiving serious attention among the prominent business men of that city and is stated to be almost an assured plan.

If the citizens of White Plains, N. Y., carry out their seeming purpose of having a municipal electric lighting plant, which is estimated to save $12,500 a year, they may be supplied with 16-candle-power lights at a cost of about one cent an hour.

One million dollars worth of non-interest-bearing stock certificates were authorized at the recent annual meeting of the Narragansett, R. I., Electric Light Company, to cover expenses of the company's equipment in suburban territory.

A contract has been closed by Messrs. Renfro & Lyons with the city council of Hawkinsville, Ga. The contractors will move their electric lighting and ice plant from Opelika to that city, as the lighting in Opelika is now done by a Montgomery company.

A municipal electric light plant will be in operation in Galesburg, Ill., within a very few days. The new plant, which is in a new building, cost the city about $41,000, the contract price for the lighting system being $33,500, and the expense of the new building $7,500.

The entire property and franchises of the South Milwaukee, Wis., Electric Light and Power Company have been formally sold to the Milwaukee Light, Heat and Traction Company by F. W. Rogers and H. M. Green, the former owners. The consideration is said to be $15,000 for the plant, lines, lamps and equipment.

A recent newspaper despatch from London, England, said it was estimated that the dense volume of smoke and fog which overhung London one day during January cost the city from $250,000 to $500,000 in 24 hours, in the matter of bills for gas and electricity. The embargo on railway traffic and other expenses make up a huge bill.

Improvements which have been in progress at the plant of the Consolidated Electric Light Company, of Birmingham, Ala., for the past six months, are rapidly nearing completion. The work has consisted in the erection of an addition to the plant which almost trebles its capacity and which will make the total amount of the company's investment about $1,600,000.

The plant of the Shamokin, Pa., Coal Township Electric Light Company will probably be built and in running order late in the Spring. For some time past it has been believed in Shamokin that the plant would not be built, but the gentlemen connected with the enterprise state that that idea is without foundation, and that the matter will be carried to a successful conclusion.

Reports from Columbus, Ohio, state that the citizens of Indianola, represented by W. H. Sharp and J. J. Chester, are looking for a chance to install an additional electric lighting plant, as the facilities of the company now operating in that town are considered insufficient. A private plant may be put in and the city will probably have an option upon purchasing it within a stated time.

Reports from Seattle, Wash., state that C. R. Collis, late manager of Seattle Gas and Electric Company, has purchased the controlling interest in the Alaskan Electric Light and Power Company, which is operating an electric light plant at Skagway. The local papers say that the purchase is likely to lead to substantial improvements in the plant and probably in the town.

Another city which is soon to own its own electric lighting plant is New Britain, Ct. What such a plant will cost the town authorities are said to have but an indefinite idea as yet, but the approximate figures have been placed at $100,000 for the initial expense. The real cost of the enterprise will depend greatly on whether the city will enter into competition with the Connecticut Lighting and Power Company in selling current to private individuals.

The long controversy for permission to light the city, which has been fought hard by the Denver, Colo., Gas and Electric Light Company, has culminated in the passing of the contract with the Lacombe company by the city officials. It is probable that the Denver company will make things interesting for the Lacombe company for some time to come, say the local papers. The lighting contract is for a 10-year term and provides for the illumination of the entire city of Denver.

A petition will be presented to the gas and electric light commissioners of the state of Massachusetts by the Boston Edison Electric Illuminating Company, for authority to issue between six and seven thousand shares of the new stock. As Edison stock is now selling for about $250 per share, a value will be placed on the new stock of about $200 by the gas commissioners, if they approve the issue. This would give the Edison company, at the very least, $1,400,000 in new capital.

Small power stations in the vicinity of Camden, N. J., are likely soon to be closed and the necessary energy for lighting villages and towns in the vicinity of Camden will come from the large power-house of the old Camden lighting and heating company, at Coopers Creek, which at present has more power than is needed to light the city. In the plant is a 1,200-horse-power engine that has been idle for a long time past, and by having a little new machinery sufficient power can be had for the purpose required.

Prominent citizens of York, N. H., recently went on a trip to Portland to investigate the lighting plant in that city, and are said to desire a lighting plant for their own town. With this in view, a bill will be introduced at the present session of the Legislature to secure such legislation as may be necessary to permit the

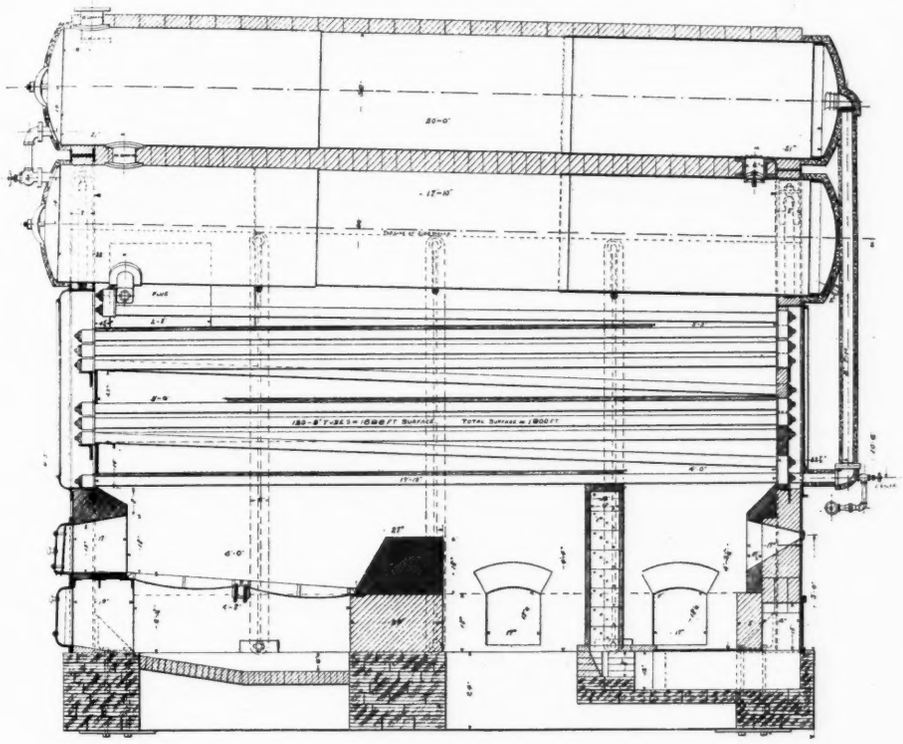
town to light its streets. The Agamenticus Light and Power Company claims the entire right of furnishing the electric lights in the town, and the citizens are said to desire their own plant.

One of the features of the Pan-American Exposition will be the myriads of incandescent electric lamps which will be used there for illuminating the grounds at night. It is said that the careful observer will notice a tinge of red in the light from these incandescent lamps, which will grow brighter and brighter as they are turned on to full incandescence. This red effect will be due to the resistance produced in the rheostat which is used for dimming effects, and is spoken of as having "the effect of a June sunrise."

The lighting situation in Columbus, Ohio, has been practically determined by the resolution adopted by the authorities, requesting facts and figures relative to municipal ownership of an electric light plant. The gist of the resolutions adopted was that the people should appoint a committee for the purpose of investigating the matter, and, if found practicable, should issue $300,000 in bonds for the purpose of erecting the plant, all this being contingent upon the authority given to the city officials by the voters of the city at the election which was held on April 6, 1896.

Manager P. H. O'Day, of Orange, Tex., has been instructed to immediately dispose of the machinery composing the present plant of the Orange Ice, Light and Water Company, with a view to installing a new plant of larger capacity. A 3,000-light machine will be put in, new poles and wires erected all over the city, and the plant extended so as to cover all portions of the city not now reached. A 900-light machine will be installed for operating a day current, and an arc light machine will also be put in. When the new equipment is finished the plant, with its enlarged capacity, will be second to none in the state of the same size.

Citizens in Northfield, Vt., had their own troubles during the recent cold weather, as the electric light plant froze up, and the town was in total darkness. The plant in question is operated by water power, and the gate controlling the wheel was frozen during the night, and could not be lowered, so that all the water left the pond. An attempt was then made to connect the steam engine at the plant, but it was found that the pump was frozen. Workmen were busy trying to thaw things out all day long, but were unable to get the machinery running, so that for two nights there were no lights at all. On the first night of darkness the thermometer registered 28 degrees below zero, and 18 degrees below at nine o'clock in the evening, while in a neighboring village the thermometer pointed to 35 degrees below at eight o'clock in the morning.



A Novel Steam Generator.

A Novel Steam Generator.

The accompanying illustration shows a longitudinal section of one type of a novel steam generator recently introduced by the Parker Engine Company, of San Francisco and Philadelphia. The peculiar novelty in the design is a regenerative system whereby a positive flow of water and steam is maintained in one direction in the tubes of the generator and many advantages secured. The generator is suspended independent of the brick work, as may be easily understood from the illustration. The upper drum is for dry steam while the lower drum is suspended in the steel framework in each end and carries the upper arm on flanged necks. The main heating surface consists of horizontal tubes arranged in vertical groups, called by the makers "elements," so as to form essentially a number of flattened coils. In the generator shown the elements are eight in number, two tubes wide and each consisting of 15 straight steel tubes three inches in outside diameter and 18 feet long. These are expanded into junction boxes at the end, the whole being exceedingly accessible and easy to keep clean. It is claimed that in this system there is always circulation, water entering the inclined tubes at one end of the system and coming out as steam at the other end. The generator looks as if it would have some advantage for quick work where it is necessary to make steam rapidly. It is in use already in a considerable number of important plants.

Iowa Telephone Association.

The fifth annual meeting of the Iowa Telephone Association will be held in the club rooms of the Savery Hotel, at Des Moines, Iowa, on Tuesday, March 12, 1901, at two o'clock P. M. The meeting will cover two days.

One of the most important questions to be discussed at this meeting is the matter of checking reports and making settlements between companies for inter-line toll business. Another very important subject which will be discussed is "Farmers' Lines;" their construction, equipment and the rates to be charged.

National Electric Light Association.

Secretary George F. Porter informs the Electrical Review that the next meeting of the National Electric Light Association will be held at Niagara Falls, N. Y., on Tuesday, Wednesday and Thursday, May 21, 22 and 23, 1901. The headquarters of the association, during the meeting, will be at the International Hotel.

Telephone and Telegraph

The steamer Ophir, on which the Duke and Duchess of Cornwall and York will soon sail for Australia, is being fitted out with a wireless telegraph system.

A franchise has been granted in Point Pleasant, W. Va., to the Southern Bell Telephone Company, recently, to compete with the local company after several stormy sessions of the town council.

A franchise has been granted by the County Commissioners to the Butler Western Telephone Company, to operate a system in the town of Hamilton, Ohio, and from there to villages in the vicinity.

Contracts have been let by the Salamanca, N. Y., Independent Telephone Company for the construction of its line to Little Valley, and it is expected that the system will be in working order within a very short time.

At the coming meeting of the Hudson River Telephone Company on March 7, an increase of its capital stock from $3,000,000 to $4,000,000 will be voted upon, the money to be used for construction and betterment.

Professor Reginald A. Fessenden and his corps of assistants, who were sent out by the government to establish wireless telegraph stations down the Atlantic coast, have completed their first installation off Roanoke Island, N. C., not far from Cape Hatteras.

It is stated that Rome, Ga., is anxious to secure a long-distance telephone line to Chattanooga, along the line of the Chattanooga, Rome & Southern Railway. This road runs through a populous district, and the benefits of such communication would be considerable.

Extensive improvements are being inaugurated by the Southern Bell Telephone Company in Jacksonville, Fla., and it is expected that in the near future all the company's wires will be placed in underground conduits in the main streets of the city as far as the waterworks.

The Rossing Electric Company, of Elyria, Ohio, which has installed telephone systems through Niagara County, N. Y., under the name of the Home Telephone Company, has accepted the franchise granted to it by Batavia under the name of the Independent Union Telephone Company.

On February 4, the Bell Telephone Company began to rebuild its system in Wellsville, Ohio, and before the improvements are completed $15,000 will have been expended. A distributing cable system will be installed, and the workmen will come direct from Parkersburg to make the changes.

The Lee County Telephone Company and the Whiteside County Telephone Company will build a copper metallic line from Clinton, Iowa, to Mendota, Ill., a distance of 75 miles. This line will complete a metallic circuit from Des Moines, Iowa, to Aurora, and Joliet, Ill., and later with Chicago.

A company of capitalists from Warren, Ohio, recently secured a franchise in Seattle, Wash., in connection with Seattle men, to construct and operate a telephone system under the name of the Seattle Automatic Telephone Company. The Ohioans interested are represented by Jules Vautrot, Jr., C. B. Sibly and E. A. Seeley.

Three handsome buildings are planned for the use of the Sunset Telephone and Telegraph Company, of Los Angeles, Cal. Equipment will be provided in them for 15,000 local subscribers, and facilities for machine and repair-shop purposes. The buildings will be of buff-colored brick, and the architecture will be in the Spanish type.

Preparations are being made by the Rome, N. Y., Home Telephone Company to connect Verona station with Verona village and Rome. The Interstate Telephone Company, with which the Herkimer County Telephone Company has recently become connected, now has a total of 108 toll stations, and local connections are made through the Rome company.

A new telephone franchise was granted recently by the village board of Bath, N. Y., granting the application of the new long-distance telephone company, which was represented by Mr. H. A. Clark, of Corning, who stated that the company would add about $50,000 of taxable property to the village, and promised a low rate and the best possible service.

A movement has been recently made in Chicago, Ill., towards securing for the city an additional revenue of something over $250,000. A sub-committee of the judiciary committee of the city council has taken up an ordinance providing for a tax of $5 per pole and 15 cents per lineal foot of conduits for all telegraph and telephone companies operating in Chicago without a franchise.

Newspaper despatches from Maryland state that probably in less than a year Frederick will have a long-distance telephone connection in all directions independent of the Bell system, plans now being on foot to connect independent lines in Maryland, Pennsylvania and Virginia, so as to form a system of this character. It is believed that there is considerable capital back of the project.

The Baiting Hollow Telephone Company was organized recently, and officers elected. The president is E. E. Mosier; secretary, J. C. Young; manager, Charles Warner. The company will start with a capital stock of $1,000, and its lines will run from Baiting Hollow east on Sound avenue, a distance of six miles, and down Roanoke avenue to Riverhead village, making 10 miles in all. It is hoped to have the system working by April 1.

Despatches from Liverpool, England, state that Professor J. A. Fleming, the electrician of London University, during a recent lecture delivered in Liverpool, stated that he had Professor Marconi's permission to say that on the first day of King Edward's reign, Marconi sent messages by wireless telegraphy from St. Catharines to the Lizard, a distance of 200 miles, and since that time he had established perfect communication betweeen those points.

The Telephone, Telegraph and Cable Company of America, at a recent meeting, elected the following directors: Jos. McCall, F. M. Jenks, C. W. Morse, H. Gawtry, G. Crocker, O. Ames, F. Tilford, Daniel O'Day, G. F. Hawkins, H. R. Wilson and W. J. Latta, F. M. Ritter, R. Morgan, J. L. Welsh, J. D. Crimmins, E. R. Chapman, Samuel Thomas, J. C. Bullitt, J. J. Sullivan, M. W. Ayers and G. W. Elkins. The first eleven are members of the old board.

A franchise was recently asked for in Le Roy, N. Y., to operate an independent telephone company in competition with the Buffalo Bell company. After this petition was heard, the Bell company in Buffalo requested the council to grant it the right to string and maintain wires and fixtures on any pole lines put up and maintained by any other company upon making arrangement with that body, and the right also to erect and maintain poles, wires and fixtures through the streets and alleys of Le Roy. Both petitions were put in the hands of a committee, and referred for further consideration at a later meeting.

An order has been obtained from the Probate Court, of Muskingum County, Ohio, by the Zanesville Telephone and Telegraph Company, fixing the method

in which it shall use the streets, alleys and other thoroughfares. The company was recently reorganized, and its capital stock increased to $200,000. The new directors under the reorganization are Judge M. M. Granger, Dr. J. Milton Fassig, Messrs. James B. Hoge and H. D. Critchfield, of Cleveland, Ohio; Messrs. Edwin S. Grant, William M. Shinnick, Rufus C. Burton, S. M. Winn, William D. Shultz, J. B. Rhodes, William C. Handshy, H. A. Sharpe, J. G. England, J. B. Owens and Sherman M. Granger.

At a recent meeting of the Eastern Shore Telegraph and Telephone Company, of Caroline County, Md., the following directors were elected for the ensuing year: Harry A. Richardson, William H. Baker and Dupont Walker, of Dover, Del.; Wilbur H. Hubbard, of Chestertown; William J. Price, Jr., of Centerville; Judge William R. Martin, of Easton; George W. Woolford, of Cambridge, and Thomas L. Day and Fred R. Owens, of Caroline County. The president's report shows that there are now 80 towns connected on the peninsula and nearly 1,000 telephones. The company is now constructing lines in Kent County and will continue them through Queen Anne County and connect with the system between Denton and Easton. It is thought this will be done in May. The officers elected are as follows: Harry A. Richardson, president; Thomas L. Day, vice-president; Fred R. Owens, secretary, and Dupont Walker, treasurer.

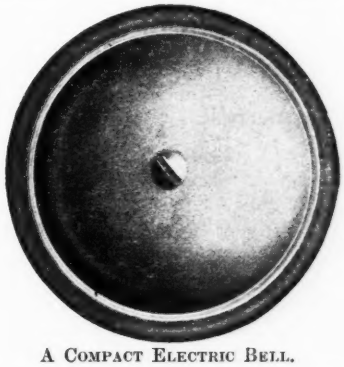
Reports from Orangeburg, S. C., state that a telephone war is in progress there which is attracting considerable attention. At a recent meeting of the council a bill was passed that no franchise should be granted other telephone companies to enter that field for a period of five years and carried the provision that the Bell company should connect the city with a long-distance line within three months. The South Carolina Long-Distance Telephone Company, an independent organization, has endeavored to establish a local exchange at Orangeburg, and a petition to grant the request is said to have been widely signed. A counter-petition to this was circulated in the interest of the Bell company, and the controversy will be taken up by the council at its next meeting. Some of the citizens claim that the conditions of the bill have not been carried out by the Bell company, and so are anxious to allow the independent company to enter the field, which company is said to have made great progress with its lines through the state, nearly all the influential towns and the low country being connected.

American Electrical Supplies Wanted.

United States Consul Marshal Halstead, of Birmingham, England, says he has been requested to announce that an English electric supply company wishes to open up correspondence with American manufacturers of electric accessories. Further information may be had by applying to Consul Halstead.

A Compact Electric Bell.

A new electric bell, very compact in construction and neat in appearance, has just been placed on the market by the Electrical Appliance Company, of Cincinnati, Ohio. Its working parts are so designed that they require a minimum of space and are so small that they are covered by a gong two and three-eighths inches in diameter. This bell is called by the manufacturers the "Queen" and is designed for use in places where a neat and artistic effect is desired. The bell is made in only one size but in several metallic finishes, such as oxidized silver, oxidized copper, nickel and polished brass.



A Compact Electric Bell.

The First Electromobile Patrol Wagon.

To the Editor of Electrical Review:

Noticing in your edition of February 16, page 234, an article in regard to an electromobile patrol wagon, and the statement that Hartford, Ct., would be the first city in the United States to own a patrol automobile, we desire to advise you that we are the "tip top" city of Ohio, and also "tip top" people, and that we have had in actual use a patrol automobile for over one year. It was built by and under the supervision of our city electrical engineer, Mr. Loomis, and a good many parts of it were manufactured at our central fire engine house by the regular firemen. Our streets here for the past three weeks have been very icy and slippery, but the patrol wagon climbed the steepest grades without any trouble at all.

Garl Electric Company,
Max Schumacher, *Sec.-Treas.*
Akron, Ohio, February 19.

Views, News and Interviews

The editor of the *Saturday Evening Post,* of Philadelphia, has evidently tried to ride from Arch street to Wissahickon Inn, or some such place, in an overworked electromobile. His view of things is expressed in this frank personal confession: "A misspent life is sad and so is a misspent automobile."

Breaking the windows of trolley cars by throwing stones is the most modern method of compelling those conveyances to stop for passengers. A St. Louis man tried the experiment a few weeks ago and it worked to perfection so far as stopping the car went. But he had a séance with the police afterward. The judge before whom he was brought finally dismissed the case.

At a recent dinner of the Correspondents' Club, of New York city, answers to the following question were read from a large number of distinguished persons: "How can the influence of the press be increased?" A large number of the replies suggested that accuracy and reliability would help the matter. Mr. Thomas A. Edison answered the question thus: "By publishing a fact now and then."

A man recently died in England from the effects of lead poisoning after having handled for three months lead-cased cables for electric lighting. In commenting upon the case and the verdict given, as above, at the inquest, the English paper reporting the affair stated that "this is the first case of the kind we have heard of, but if there be risk of lead-poisoning in carrying out such work as the laying of electric lighting cables, surely it could be obviated by the men while so employed wearing a gauntlet or piece of leather in the palm of the hand."

Two cases of "X-ray eyes" have been reported within the last month. In the first instance the mystic claimed to be a "divine healer," who by merely looking into the suffering bodies of her patients could diagnose their cases at once and then heal them by the laying on of her hands. Now comes a similar story of a young man in the Southwest whose X-ray vision is so keen that he can locate mines, oil, gas and various other interesting money-makers. That "there is nothing new under the sun" appears somewhat doubtful in the light of these two remarkables who were dragged out of obscurity by the ubiquitous reporter.

Corporation News

ALBANY, N. Y.—New Berlin Telephone Company. $3,000.

JEFFERSON CITY, Mo.—Spring River Electric Company. $50,000. Incorporators: Frank S., E. C. and S. D. Chesney.

LITTLE ROCK, ARK.—Huntington Electric Light and Power Company. $8,000. Incorporators: W. Harper, M. Hayes and others.

COLUMBUS, OHIO — Ohio Northern Traction Company, of Toledo. $25,000. Incorporators: J. W. and A. B. Cable and others.

NASHVILLE, TENN. — Dixie Electric Motor Company. $30,000. Incorporators: W. Goodman, T. G. Galbreath and others.

JACKSON, MISS. — Natchez Electric Street Railway Company. $150,000. Incorporators: A. G. Campbell, T. O. Baker and others.

COLUMBUS, OHIO—Van Dorn-Elliott Electric Company. Capital, $50,000. Incorporators: J. H. Van Dorn, F. Schneider and others.

INDIANAPOLIS, IND.—Lafayette, Purdue & Northern Traction Company. $8,000. J. B. Book, A. A. Purman and others, directors.

PIERRE, S. D.—Dakota Telephone and Electric Company, of Geddes. $150,000. Incorporators: G. E. Wickes, E. C. Ward and Frank Ecksline.

SPRINGFIELD, ILL.—Crowdus Automobile Company, Chicago. $100,000. incorporators: J. S. Jacoby, E. Atherton and F. N. Warren.

SPRINGFIELD, ILL.—The Electric Laundry and Machine Company, of Chicago. Capital, $25,000. A. M. Fraser and others, incorporators.

SPRINGFIELD, ILL. — Illinois Motor Transit Company, Champaign. $50,000. Incorporators: J. Armstrong, J. T. Ainsworth and S. D. Enochs.

COLUMBUS, OHIO—Toledo Railway and Terminal Traction Company; $10,000. Citizens' Electric Light, Heating and Power, of Shreve; $10,000.

ALBANY, N. Y.—Genessee Valley Telephone Company, of Rochester. Capital, $100,000. J. F. Warner, G. R. Fuller and E. M. Higgins, directors.

ALBANY, N. Y.—Stein & Langlos Manufacturing Company, New York city. Capital, $10,000. Directors: George Stein, W. V. Langlos and C. F. Kabisch.

SPRINGFIELD, ILL.—London Power and Electric Company, London Mills. Capital, $25,000. Incorporators: Frank Shelby, F. J. Daines and E. S. Marston.

LANSING, MICH. — Homer Electric Light and Power Company; $14,000. The Detroit Motor Works has increased its capital stock from $10,000 to $25,000.

JEFFERSON CITY, Mo.—Peoples' Telephone Company, of New Florence, Montgomery County, Mo. $3,100. Incorporators: H. Ellis, W. C. Crone and others.

SPRINGFIELD, ILL. — Bradley Park Heat, Light and Power Company, of Peoria. $100,000. Incorporators: J. E. Fisher, W. H. Ballance and J. A. Keathley.

INDIANAPOLIS, IND. — Jeffersonville, New Albany & Sellersburg Rapid Transit Company. $10,000. Directors: Louis Schneck, George Holzburg and John Burmont.

JACKSON, MISS.—The Meridian Electric Light and Railway Company. Capitalized at $225,000, with the following incorporators: J. Kamper, R. W. Stoutz, William Ambrecht.

COLUMBUS, OHIO—Wapokoneta & Kenton Traction Company, of Columbus; $5,000. Ohio Traction and Finance Company; $10,000; incorporators: J. H. Smart, J. A. Thompson and others.

COLUMBUS, OHIO — Jones Brothers Electric Company, of Cincinnati, increased its capital stock from $136,000 to $400,000. C. E. Jones, president, and H. R. Kooper, secretary and treasurer.

HARRISBURG, PA.—The New Traction Company, of Allentown, and the Cooperstown Street Railway Company have been consolidated with a capital stock of $1,500,000 and a bonded debt of equal value.

FRASERVILLE, QUEBEC—La Compagnie Electrique de Rimouski has been incorporated with a capital stock of $100,000 to furnish electric light and power. Incorporators: Thomas Lebel, J. N. Pouliot and A. C. Landry.

MADISON, WIS.—Milwaukee, Burlington & Lake Geneva Railway Company. $100,000. Incorporators: T. W. Wheeler and I. N. Bick, of Toledo, Ohio; Mrs. Isabelle Debouchet, of Paris, France, and J. S. O'Connor, of Milwaukee.

SACRAMENTO, CAL. — The American Wave Motor Company, of Los Angeles, has been incorporated with a capital stock of $300,000, with a paid-up stock of $150,000. Directors: A. J. Stevent, Vincent Gifford, D. S. Gillespie and others.

TRENTON, N. J.—Keystone State Telephone and Telegraph Company; $2,000,000; incorporators: Norman Prey, E. H. Chew and W. B. Wolcott, all of Camden. Newton Stewart & Paoli Telephone Company; $350; incorporators: W. T. Swift and others.

TRENTON, N. J.—Sussex Light and Power Company. $500,000. Incorporators: F. J. Myers, A. T. Rice and others. The company is authorized to erect dams in the Delaware River, where the state boundary line intersects the line of the states of New York and Pennsylvania.

COLUMBUS, OHIO — Dayton, Springfield & Urbana Southwestern Railway Company; $250,000. Springfield & Western Railroad Company; $100,000. The Madison Telephone Company has increased its capital stock from $40,000 to $75,000.

ALBANY, N. Y.—The Susquehanna Power Company, with an authorized capital of $100,000, will probably be authorized to construct dams or reservoirs on the Susquehanna River in Otsego County, outside of Oneonta, to be used for the development of hydraulic and electric power for light, heat, power and other purposes. It is understood that the Oneonta, Cooperstown & Richfield Springs Railway Company is interested in the new concern, whose incorporation was proposed by Senator Feeter.

COLUMBUS, OHIO—Columbus, Findlay & Toledo Electric Power, Fuel and Light Company; $10,000; incorporators: A. J. Jones, J. D. Miller, A. M. Hastle and others. Findlay & North Baltimore Railroad Company; $150,000; incorporators: Colonel J. A. Bope, C. F. Smith and others. Toledo & Southern Railway Company; $25,000; incorporators: B. F. James, G. A. Smith and others. Cincinnati Automobile Company; $25,000; incorporators: E. Spray, B. Albright, A. Leisure and others. Tri-County Telephone Company, Greenwich; $25,000. Elyria, Grafton & Southern Railway Company; $10,000. The Greenville Electric Light and Power Company, Greenville, has filed an amendment to its charter for enlarging its field of operation.

Cincinnati Street Railway Sold.

At a meeting of the Cincinnati, Ohio, Street Railway Company recently held in that city it was decided by a three-fourths vote of the stockholders to turn the road over to the Widener-Elkins syndicate, which a short time ago organized the Cincinnati Traction Company, which has been organized with the following officers: President, Hugh J. McGowan, of Kansas City; secretary and treasurer, William T. Irwin, Cincinnati; directors, Judge Schmidlapp, Charles E. Proctor, Cincinnati; William T. Sheehan and Harry M. Levi, New York; William Kelsey Schoepff, Pittsburgh, and Randall Morgan, Philadelphia.

Truth Tersely Told.

[*From the Electrical Review, London.*]

The scientific investigator supplies the seed of a great industry, the inventor plants it, the engineer acts as gardener, but labor and capital have to supply the not less essential soil for its growth.

American Steel and Wire Company's Officers and Directors.

At the annual meeting of the stockholders of the American Steel and Wire Company, held in Jersey City, N. J., on February 19, the following board of directors was elected: Thomas F. Ryan and H. Clay Pierce, taking the places of Herman Seilcken and Phillip W. Moen; Alfred Clifford, William P. Palmer, F. H. Chisholm, Randal Morgan and P. A. B. Widener. The actions of the board during the fiscal year were approved, and certain amendments to the by-laws were adopted. Chairman Clifford's report was a duplication of the one issued to stockholders on January 29. Mr. Clifford stated that the outlook for business for the current year was very bright.

The directors of the company, at a meeting on February 20, elected the following officers and executive committee: John W. Gates, chairman of the board; William B. Palmer, president; William Edenborn, first vice-president; J. S. Keefe, second vice-president; P. W. Moen, third vice-president; S. H. Chisholm, fourth vice-president; F. S. Watson, treasurer; T. P. Adler and A. F. Allen, assistant treasurers; C. S. Roberts, secretary; F. E. Patterson and A. F. Allen, assistant secretaries; C. A. Honecker, auditor; Max Pam, general counsel. Executive committee: J. W. Gates, William Edenborn, P. A. B. Widener, Thomas F. Ryan, John Lambert, H. Clay Pierce and William P. Palmer.

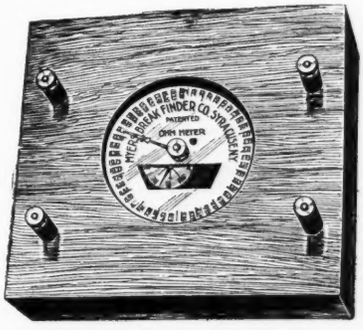
Project for a Great Canal and Electric Boats.

Governor Odell, of New York, has received from State Engineer Bond plans for an entire new canal system for the state. The Governor has approved them, and they will be presented to the Legislature in a few days. The plan is for a barge canal capable of accommodating boats of 10 feet draught, to be propelled by steam or electricity, for the entire route of the Erie, Champlain and Oswego canals. The cost of the proposed improvement is estimated at $50,000,000. Should the present Legislature adopt the proposed plans they will go before the people at the next general election, and when endorsed by popular vote the necessary bill must be repassed by the Legislature before bonds for the $50,000,000 required can be floated. The new canals could carry 15,000,000 tons of freight in a season of seven months. A number of prominent men and several well-known financiers have approved the plans.

Wall Street and the Electrical Stock Market.

The exchanges were ordered closed on Friday and Saturday of this week on account of February 22 being a legal holiday.

On the New York Stock Exchange, General Electric closed on Thursday at 212 bid and 214 asked, showing a gain of 1½ points. Metropolitan Street Railway, of New York, closed at 162½ bid and 163 asked, indicating a loss of ¼ point. Brooklyn Rapid Transit closed at 75⅝ bid and 75⅞ asked, showing a loss of 1⅜ points for the week. Third Avenue Railroad closed the week at 120 bid and 122 asked, showing a loss of 1 point. Manhattan Railway, of New York, closed at 117 bid and 117¼ asked, showing a loss of ⅜ point.



A Direct-Reading Ohmmeter.

On the Boston exchange, American Telephone and Telegraph closed at 161½ bid and 162 asked, indicating a loss of ½ point. Erie Telephone closed at 61 asked, and no bid price quoted, indicating a loss of 1 point in the asked price. New England Telephone was not quoted.

On the Philadelphia exchange, Electric Storage Battery was not quoted. Electric Company of America closed at 8⅝ bid and 8¾ asked, showing a gain of ⅝ point for the week. Union Traction closed at 33⅜ bid and 33⅝ asked, showing a loss of ⅞ point for the week.

On the curb, or outside market, in New York, Electric Vehicle closed at 14½ bid and 15½ asked, indicating a loss of 1 point. Electric Boat closed at 24 bid and 26 asked, showing a loss of 2 points for the week. Consolidated Equipment closed at 11 bid and 11½ asked, showing a gain of 1½ points.

Wall street, February 21.

If the medical man who declares that the little toe is rapidly disappearing from the foot of man is correct, there will still be left some comfort in life—the burly trolley car conductor will have one thing less to tread on.

A Direct-Reading Ohmmeter.

The Myers Break Finder Company, of Syracuse, N. Y., is selling a novel direct-reading ohmmeter which is illustrated herewith. The containing case is highly finished and is about nine inches square and two inches deep. The case contains a magnetic needle which is just visible through an opening cut in the dial. Along the periphery of the dial is a scale containing, in the instrument shown, 100 subdivisions. On these subdivisions are printed in this particular instrument numbers which represent ohms from .5 to 20.26 inclusive. The manufacturer can increase this scale up or down to any extent desired. Over the dial circles a pointer like the hour hand of a clock. The instrument is to be placed in such a position that the delicate needle, visible behind the glass, will swing over the zero mark. The operator attaches wires, which have been connected to any source of direct electrical current to two of the binding-posts shown in the cut. The unknown resistance under test is to be connected with the other two binding-posts. This will swing the small needle, visible behind the glass, away from zero.

The pointer must now be turned, and this operation will force the needle either further away from the zero point or back toward it. The operation must be continued until the needle behind the glass has been forced entirely back to the zero point. When this is accomplished, the hand above the dial will then point directly to the required resistance of the coil, magnet or whatever it may be that is under test.

For use under conditions, where for obvious reasons the delicate needle behind the glass would be unreliable, the manufacturer furnishes a telephone receiver in connection with the instrument, and this will indicate by sound when the turning hand has reached the required resistance. This instrument has many advantages claimed for it, among them being: Expert experience is unnecessary; quick readings are possible; the readings are given directly in ohms; the instrument has no plug contacts, thus removing the possibility of imperfect connections; the instrument can stand the severest abuse without derangement; if desired, it is furnished so as to be independent of mechanical or electrical outside effects; if desired, it can be arranged for use in the most awkward positions, and be made independent of leveling; it can be connected directly to any direct electric lighting or battery current.

Industrial Notes

THE ERICSSON TELEPHONE COMPANY, New York city, states that in the cylinder type of the Poulsen telegraphone, Mr. Valdemar Poulsen, the Danish engineer, uses the Ericsson transmitter and receiver.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is selling agent for Richmondt electrogalvanized wire conduit tubing, and is now sending out advertising matter giving full information regarding it.

THE WARREN ELECTRIC AND SPECIALTY COMPANY, Warren, Ohio, is announcing for the season's trade the new "Peerless" fans in all the essential designs. This company is taking the unique position of offering "the highest priced fan" on the market.

MR. A. W. BRODE, 456 South Broadway, Los Angeles, Cal., announces that he has purchased the business and good will of the Clemans Electrical Works, which was one of the oldest houses in Southern California. Mr. Brode states that he will be pleased to receive catalogues, price lists and descriptive matter from manufacturers and dealers.

THE COUCH & SEELEY COMPANY, Boston, Mass., has sent out "Some More Telephone Talk," illustrative of tubular drops, combined jack and tubular drop, combined ringing and listening key, plugs and metallic jacks. The illustrations are clean cut and the descriptive matter clear and pertinent. The folder will be mailed upon application to the company.

THE GENERAL INCANDESCENT ARC LIGHT COMPANY, 572 First avenue, New York, is mailing its catalogue No. 30. The folder contains full descriptions of push-button switches and plug receptacle and automatic switches. The new type of G. I. flush push-button switch is shown and the list will be mailed to any one interested upon application to the company.

THE PITTSBURGH INSULATING COMPANY, Pittsburgh, Pa., is said to have developed a process by which it can coat paper and cloth with Sterling insulating varnish and produce an article perfectly uniform in thickness and insulation. The company states that it is prepared to send out samples of these papers, and desires to have any purchasing agents or engineers who require such material, make inquiries regarding it.

THE AMERICAN STEEL AND WIRE COMPANY, New York and Chicago, is mailing its "List of Products." The book is a neat little 28-page folder, bound in dark green, and enumerates all the manufactures of the company in such a manner that they can be easily located. The book will be sent to any one interested upon application to the company's Chicago office in the Rookery Building.

THE INTERNATIONAL CORRESPONDENCE SCHOOLS, Scranton, Pa., are said to have been uniformly successful in bettering the conditions of their graduates and as an instance of this is cited the case of the recently appointed superintendent of coal mines for the Mexican International Railroad Company, at Fuente, Mex., who was assisted in securing the position by the Students' Aid Department of the schools.

THE WESTERN ELECTRIC COMPANY, Chicago, Ill., is mailing circulars relative to its large stock of lead-covered and braided rubber-covered cable, which it states are to be offered at very attractive prices for immediate delivery. A large quantity of weatherproof cable and wire from the largest to the smallest commercial sizes is also listed by that company. Particulars will be sent upon application to the Chicago office.

AMONG THE CONTENTS of *McClure's Magazine* for March will be "What We Know About Mars," by Edward S. Holden, formerly director of the Lick Observatory; "Billy's Tearless Woe," a story written and illustrated by Frederic Remington; "The Law of Life," an Alaskan story, by Jack London; "Dan McCarthy," a story of the New York police, by J. Lincoln Steffens; besides other short stories, an instalment of "Kim," by Rudyard Kipling, and a poem by Josephine Dodge Daskam.

MOLONEY TRANSFORMERS, built by the Moloney Electric Company, of St. Louis, Mo., are constructed with particular reference to the aging qualities of the core metal employed. As is well known all iron used in transformer cores increases in hysteresis loss with time, this phenomenon being known as aging. By careful treatment and selection of iron of the proper composition this detrimental effect can be almost entirely obviated and in the transformers in question this has been done very carefully.

THE NEWTON ELECTRIC COMPANY, 134 West Broadway, New York city, has recently undergone a reorganization and enlargement of its facilities. Mr. Ralph Straschnow, who has been identified with the interests of Schiff, Jordan & Company, Vienna, Austria, has associated himself with the Newton company as vice-president and treasurer. The company is preparing a new catalogue, which will include a description of the following specialties: flush switches, flush plug receptacles, door fixtures, arc light ceiling switches, etc. This line of specialties will be added to by the company in the near future.

JAMES L. ROBERTSON & SONS, 229 Fulton street, New York, state that their factory is busily engaged in turning out indicators, improved Victor reducing wheels, and the improved Willis planimeter. The company note the increased use of engine indicators and state that while a few years ago such instruments were sold chiefly to experts in limited quantities, the average engineer now in any sizable plant feels that his outfit is incomplete without one. The makers state that these indicators are of such a wide range that they will take any stroke up to five feet or speed up to 500 revolutions by merely changing a bushing. Catalogues containing descriptive matter and full prices will be mailed upon application to the company.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis and New York, states that its factory is working to its full capacity on the manufacture of the Emerson fans and motors. In order to make the fans with the special hardened steel shafts which are a feature of the company's product, it was necessary to have special grinding machines, and in order to get the machines, the Brown & Sharpe Manufacturing Company, of Providence, R. I., sold the Emerson company a special grinding machine which had been made up as a part of the B. & S. exhibit at the Pan-American Exposition, and which the latter company considers to be the very latest and most improved type of grinding machine so far manufactured for the purpose for which it is used.

THE GILLILAND ELECTRIC COMPANY, Adrian, Mich., has resumed on a large scale the manufacture of telephone and electrical specialties. The company, which was organized in 1887, for many years manufactured all the pins and brackets for the largest telephone and telegraph companies in the United States. Mr. James F. Gilliland, the manager of the company, is one of the best telephone men in the business, and comes of a family of well-known telephone men. He has invented and patented a large number of electrical and telephone devices. The Gilliland company has installed complete wood and metal-working machinery and is prepared to furnish all forms of cabinet work, pins and brackets, and is also equipped to manufacture many specialties which ordinary manufacturers could not handle. Its plant, with a capacity for 1,000 men, enables it to fill all orders with promptness, and its favorable situation gives it exceptional advantages with regard to the cost of manufacture. Every article manufactured by the Gilliland company will be of the highest grade of quality and absolutely guaranteed.

THE AMERICAN BRIDGE COMPANY, New York city, announces that it is very busy at the present time, having taken a number of large contracts for structural steel, which includes three viaducts and a 300-foot draw-span for the C. B. & Q. Railroad, 3,500 tons of material for the Rock Island Railroad, and similar orders of material for a highway bridge, New York city, the Oregon Short Line, 25 highway bridges in Kansas, all the structural steel for the new 14-inch continuous mill for the Carnegie Steel Company, at Duquesne, Pa., the steel work for the new armory at Medina, N. Y., a large steel building to be used as a blacksmith shop for the A. T. & S. F. Railroad Company, at Topeka, Kas., seven buildings for the Sterling White Lead Company, at Kensington, Pa., a pier and warehouse at Progreso, Yucatan, Mex., which will be 40 feet wide and 550 feet long, eight-inch solid steel piles being used, the steel work for the 10-story office-building to be erected by the Mutual Savings Bank in San Francisco, Cal., the structural steel for the office-building to be erected by the Surety Investment Company in East Denver, Colo., and a quantity of steel work of various sorts to the Bureau of Yards and Docks for building No. 22 at the New York Navy Yard in Brooklyn. The company announces that its New York contracting office will hereafter be in charge of Mr. S. Fischer Miller, formerly with Milliken Brothers. Among Improvements to be inaugurated by the company is a steel plant for the Allegheny Steel and Iron Company.

THE CROCKER-WHEELER COMPANY, Ampere, N. J., reports these sales for the month ending with February 15: The following direct-connected generators have been sold: Schwartzchild & Sulzberger, two 250-kilowatt; United States Mint, Philadelphia, Pa., two 200-kilowatt, one 150-kilowatt, one 75-kilowatt; Brown Shoe Company, St. Louis, Mo., one 200-kilowatt; Hahne & Company, Newark, N. J., two 200-kilowatt, one 100-kilowatt; E. I. DuPont de Nemours, Wilmington, Del., one 200-kilowatt; Navy Yard, Washington, D. C., two 150-kilowatt; National Electric Supply Company, Washington, D. C., one 50-kilowatt; Bement, Miles & Company, Philadelphia, Pa., one 50-kilowatt; Toledo Bridge Company, Toledo, Ohio, one 50-kilowatt; White Star Line, one 50-kilowatt. In addition to these, the following motors have been sold: Philadelphia Engineering Works, Philadelphia, Pa., 46 motors, aggregating over 700 horse-power. This makes upwards of 3,000 horse-power already sold to that company. Pencoyd Iron Works, four motors, aggregating 60 horse-power, making over 4,000 horse-power already sold to them. Schwartzchild & Sulzberger, two 75 horse-power, two 50-horse-power, seven 25-horse-power, 14 motors, aggregating 160 horse-power, in addition to 500 horse-power already sold to them. Various smaller sizes of motors have been sold as follows: The Link Belt Machine Company, Philadelphia, Pa.; Howard Iron Works, Buffalo, N. Y.; Maris Brothers, Philadelphia, Pa.; Richmond Locomotive and Machine Works, Richmond, Va.; National Tube Works, McKeesport, Pa.; Kansas City Electrical Manufacturing Company; Armour & Company, Chicago, Ill. (Who have already bought over 1,300 horse-power motors and generators); New York Ship Building Company, Monesen, Pa.; Hilles & Jones, Wilmington, Del.